S. HRG. 101-725

SUSTAINABLE AGRICULTURAL DEVELOPMENT IN ETHIOPIA

HEARING

BEFORE THE

JOINT ECONOMIC COMMITTEE CONGRESS OF THE UNITED STATES

ONE HUNDRED FIRST CONGRESS

SECOND SESSION

FEBRUARY 27, 1990

Printed for the use of the Joint Economic Committee

U.S. GOVERNMENT PRINTING OFFICE

30-597 WASHINGTON : 1990

For sale by the Superintendent of Documents, Congressional Sales Office
U.S. Government Printing Office, Washington, DC 20402

JOINT ECONOMIC COMMITTEE

[Created pursuant to sec. 5(a) of Public Law 304, 79th Cong.]

CONTENTS

WITNESSES AND STATEMENTS

TUESDAY, FEBRUARY 27, 1990

SUBMISSIONS FOR THE RECORD

TUESDAY, FEBRUARY 27, 1990

SUSTAINABLE AGRICULTURAL DEVELOPMENT IN ETHIOPIA

TUESDAY, FEBRUARY 27, 1990

CONGRESS OF THE UNITED STATES,
JOINT ECONOMIC COMMITTEE,
Washington, DC.

The committee met, pursuant to notice, at 9:06 a.m., in room SR-253, Russell Senate Office Building, Hon. Albert Gore, Jr. (member of the committee), presiding.

Present: Senator Gore.

Also present: David Freshwater and Frankie King, professional staff members.

OPENING STATEMENT OF SENATOR GORE, PRESIDING

Senator GORE. The hearing will come to order. Let me welcome everyone and get the proceedings underway.

In the last few weeks the specter of yet another famine in Ethiopia has been drawn to the world's attention. While the threat of famine is cause for immediate action, the Joint Economic Committee is holding today's hearing as a way to draw attention to Ethiopia's longrun future.

Preparation for this hearing began long before evidence of another famine was available, because we see evidence of long-term problems beyond those caused by drought. Our concern is the critical issue of achieving long-term, sustainable agricultural development in Ethiopia and dealing with the causes of these repeated famines.

Data from the World Bank show that between 1980 and 1987 per capita food production in Ethiopia declined by 12 percent. While some of this gap is offset by imports, Ethiopia has the agricultural potential to not only feed itself, but also to help supply other countries. A more productive agricultural sector can also be more environmentally sound. At present, erosion and soil depletion are major factors in lowering the level of output of Ethiopian farmers. Resolving these two major problems is critical to future development.

Even in the face of immediate threat of famine, our task today is important. Failure to reverse the longrun trends of: environmental degradation, explosive population growth, and declining agricultural production, spells long-term disaster for Ethiopia and repeated famine. With the help of our witnesses today we hope to develop the information necessary to begin putting together the start of a strategy for sustainable agricultural development in Ethiopia. The

premise for discussion of this sort is an Ethiopia in which there is peace and where government policy for agriculture has some rational basis. In the Ethiopia of today it takes an act of faith to believe that this time will come, but we must believe that one day it will, and we should prepare ourselves for the opportunities that will then be presented. Similar acts of faith involving Eastern Europe and South Africa seem to have been justified by recent events.

Other committees of the Congress are assessing the need for famine relief to deal with the horror of the immediate crisis. The Select Committee on Hunger, in conjunction with the Subcommittee on Africa of the House Foreign Affairs Committee, is holding a hearing tomorrow afternoon to focus on this issue. The Joint Economic Committee, however, has a longstanding interest in sustainable agriculture that our hearing today continues. Together, all our efforts will help to draw attention to the needs of Ethiopia and suggest ways to improve the future of the Ethiopian people.

In the first panel of witnesses we hope to examine the current status of conditions in Ethiopia and the factors underlying the present situation.

The second panel, made up of spokespersons for nongovernmental organizations that have major Ethiopian programs, will provide perspective on developmental needs and approaches.

The final panel has the task of addressing the problem of where to go from here; what sort of development strategy should be pursued.

I would like to add just a personal word about the genesis of my own participation in studying this issue. I had a longstanding interest in it but not a great deal of involvement until I encountered a friend named Ivan Tillem. He had a vision of sustainable agricultural development in Ethiopia which he imparted to me with enthusiasm and great energy. Because of that friendship, I arranged discussions with yet another longtime friend, Mickey Leland. Mickey and I served in the House of Representatives together and were especially close. And the three of us, Mickey Leland, Ivan Tillem, and I, had a number of discussions about how this project might be pursued in an intelligent, sustained, and productive way.

Indeed, it was during one of those breakfast discussions that the ill-fated trip to Ethiopia by Mickey Leland and Ivan Tillem was conceived. I was supposed to have been a member of that traveling party as well. But because of an injury to my son last year my plans were dramatically changed and they proceeded to Ethiopia without me. But I determined to do my best to continue the focus and attention on the work they began.

Of course, Mickey Leland was involved in a wide range of efforts to assist the starving in Ethiopia and elsewhere, and this was only one of his many initiatives. It was the principal initiative of Ivan Tillem, and the first initiative of which I became aware, that might offer some basis for hoping that Ethiopia could find its way out of this sequence of repeated famines. I wanted to add that personal note, to say to those of the caring community who have been so long involved in these efforts, that I hope to play some small part in furthering your efforts and focusing our common desire to find a

longer term solution to the problems that have occupied so many for so long.

PANEL I. THE CURRENT FOOD SITUATION IN ETHIOPIA

I am delighted to have such a distinguished panel of witnesses here today. I will introduce each panel as we get to it, beginning with the first panel which is made up of John W. Harbeson, professor of political science at the City University of New York; Paul Henze, resident consultant with the RAND Corp.; and Raymond Copson, specialist in international relations with the Congressional Research Service.

We will begin with you, Professor Harbeson. Our common practice is to ask unanimous consent at the beginning of the proceeding to put the prepared statements of all witnesses into the record at the appropriate place. And without objection, that will be done. We invite you to summarize the most salient points as you see fit. But make sure that we get all that you believe we should absorb as a result of your appearance here. So, we are counting on you to get us off to a good start.

STATEMENT OF JOHN W. HARBESON, PROFESSOR OF POLITICAL SCIENCE, CITY UNIVERSITY OF NEW YORK

Mr. HARBESON. Thank you, Senator Gore. It is a pleasure to be invited here and I am very pleased as I am sure my colleagues are with your involvement and interest in this widely important area.

I think what I can do to be most hopeful in this very important hearing is to talk about some of the political and policy underpinnings of the current agricultural crisis. Others on this panel and later today are much better qualified to talk about the particular agricultural issues in technical detail, which I am not prepared to do. It is no secret, and it is common understanding that the Ethiopia of today is the poorest country in the world by all the standard vital statistics that the World Bank supplies us with on an annual basis.

It is also the case in terms of measures of growth in general terms, agriculture in particular, and agricultural exports that Ethiopia's vital signs look extremely poor, even by sub-Sahara African standards, and that is not a particularly high standard these days. Underlying those very discouraging vital signs is a great deal of what I would say is structural disarray in terms of the political economy of Ethiopia.

In the first place productivity in the agricultural area is declining, somewhat compensated by increases in acreage, but overall declining in productivity. And the question is, What is that? One of the reasons is seriously inadequate investment in agricultural research and extension. Ethiopia has a foundation for a very fine agricultural research and extension, but that has not been sustained in recent years. In addition the agricultural extensions' staff who are the vital links between science and the Earth have been diverted to more institutional purposes by the Government.

Furthermore, there is a great deal of land tenure insecurity. That was one of the reasons for the revolution that was to be in the first place. But there is still a great deal of land insecurity oc-

cassioned by the fact that land reform even if it is good in concept needs to be maintained. Demographic changes by themselves can upset a land reform program like the one in 1975 that in concept at that point in time might have made sense.

Furthermore, there have been rapid successions, further iterations, of land reform from the initial one in 1975 to more collectivized forms in 1979. So, the process of institutional change in agriculture has been rapid and not productive in part because the codification of the reforms, even if they are OK in principle—and that is a debatable issue of course—have not been kept up. So, a great deal of land tenure insecurity has occurred as a result of uncodified change regardless of the merits in the first place.

Furthermore, there has been seriously inadequate access to productive resources in terms of credit marketing facilities, prices, all of the extension assistance. All of the requirements for successful agriculture have been skewed in favor of collective agricultural institutions rather than the individual, in favor of large-scale enterprises as opposed to small ones, in favor of agriculturists over pastoralists. As was the case in the old regime, there are a few regions that have accounted for almost all of the agricultural development of the country at the expense of others being left to wallow. It parallels the experience of the old regime and perhaps exaggerates it.

Moreover, despite the overwhelming evidence that small-scale producers are the most efficient users of scarce resources, the state farms and large-scale enterprises have been given priority, almost an absolute priority over the small-scale farmers. And I would comment at this point, I think that the World Bank in the structural adjustment programs started out talking about emphasizing small scale. And I do think that that has been diluted by multilateral donors.

Senator GORE. Has been what?

Mr. HARBESON. Diluted. The theme of emphasizing small-scale agriculture has been soft pedaled in subsequent iterations in the World Bank adjustment policies. Moreover, the scale and pace of public management of agriculture has been—I guess demonic is the best word to describe it. Even if villages might have some legitimacy in principle if properly constructed and carefully planned, and it may be that resettlement might have some merit if properly constructed and planned—indeed there was some very creative small-scale NGO managed resettlement in the old regime. Even if the principle is not wrong, the management of it and the scale and pace of it as everyone knows has been so extreme as to be really suicidal.

What underlies the structural disarray? I think there are two fundamental issues that cannot be ignored in this context. The wars and the political strife are clearly a direct cause of agricultural disarray. The Government simply has been unable to devote the resources necessary to agriculture given the war effort. And, indeed, as I have argued in some of my writings, the Government has made agricultural development a theater of the war effort and attempted to manage agriculture by martial means. And that is part of the problem, too.

I think it is important to recognize that those wars are not petty disputes. There are some fundamental issues, constitutional issues,

that underlie those disputes which must be mediated at some level. One is simply the definition of Ethiopia. Ethiopia is an empire; it is an African empire. But unlike other empires, there has been a great deal of cultural cross fertilization so that the historic definitions of colonized and colonizer are not quite so sharp. This creates a basis for some reconciliation in principle.

But the problem is that both Haile Selassie's government and the Mengistu government have greatly polarized those relationships: Haile Selassie by canceling—quashing—the Eritrean Federation, and Mengistu by insisting upon military settlement at all costs. This has greatly polarized things and diminished the possibility of a reconciliation. This has drained resources, but also has undermined the fabric of an Ethiopian polity to the point where it is not only a war-torn society, but one that is really greatly weakened. I wouldn't say that Ethiopia is in danger of becoming a Lebanon, but it is weakened as one consequence of the war effort. A political solution is required. The only question is when it will occur, whether it be before or after Eritrean independence or before or after a Tigrean victory. And I think the ultimate answer, whether confederal or federal, is a decentralized Ethiopian polity.

I have heard representatives on both sides agree recently that in principle some sort of more decentralized confederal or federal organization in the country is historically legitimate in Ethiopian terms the basis for solution. The question is making that happen.

The second issue that I think is important is really the question of the process of political change in Ethiopia. In addition to the conflict over Eritrea, there is the earlier conflict over how the revolution that was to be should be accomplished. Is it legitimate to have military leadership? Should political change take place before agricultural and economic change or the other way around? And those issues were fundamental and responsible for some of the urban civil war that took place in the 1970's. And it is my impression that those issues are still there. And once the Eritrean, Tigrean wars and the other wars are resolved, those issues will resurface.

I think there are a number of policy issues that need to be addressed. I would like to say that once we get past these macro issues there are specific policy issues that need to be addressed. One is the question of land tenure. I have seen it said frequently that the issue is the privatization of land tenure. And I think that that is an inaccurate statement. First of all, it would be a mistake to say that the land tenure systems were private in quite the English and American sense of that term. It is important to recognize that.

It is also the case with earlier land reform in 1975—one that was much more associational and much less collective than the one featuring producer cooperatives and so forth—struck a balance between the private and the collective. And I think it is important to recognize that a solution to land tenure insecurity in Ethiopia has to be an Ethiopian solution which might stop somewhat short of full privatization. And, indeed, the 1975 reform appeared to be broadly acceptable to many Ethiopians in that sense.

The second issue is the question of resettlement. As I said before, I think that the resettlement properly planned and at the right

place is perhaps legitimate in the sense that it took place in earlier times. There is overcrowding in northern Ethiopia and there is less crowding in southern and western Ethiopia. So there is a case for resettlement. The question is: How to do it and do it right?

Third, I would urge you not to ignore the concerns of the pastoralists. Ethiopia has considerable pastoral potential. Its livestock industry has great potential, and it has been systematically ignored. I know that particularly in the Awash Valley, despite the initial idea that the settlement schemes were for pastoralists, they bypassed pastoralists. They were for agriculturalists with the pastoralists sitting on the sidelines.

Fourth, I would urge you to focus on the question of cooperatives. There are many kinds of cooperatives. The producer cooperatives, the fully collectivized ones, have not been a success. But there were service cooperatives, marketing, and service cooperatives, that were created under the 1975 reform which showed great potential and, indeed, needed to be encouraged. It is not a question of abandoning cooperatives. It is a question of abandoning the highly collectivized variety that the Government has tried to push in the last few years.

And there is the question of state farms. Everybody knows that state farms—except for producing the needed marketable surplus—have been a waste, inefficient, and bankrupt. But there is a question of how one deals with those state farms already in place, how one deals with those producer cooperatives already in place. There is a question of dismantling or reorganizing the ones in place, which if not done right will produce a great deal of additional insecurity, loss, and efficiency. People are abandoning the villages even as we speak. What happens to those people who as a result are basically rootless now. One needs to think about how to transform those institutions already in place that have not worked.

I would urge you, finally, to think in terms of implementation of any policy changes that are brought about. And here I think that management reform is terribly important. There is lots of lipservice given, and has been for many years now, in both multilateral and bilateral agencies to the question of management reform. But I think it has been largely ignored. There is a large body of field tested new management focusing on participation, matrix management, informal structures, bureaucratic learning, delivering services, localized adaptation, and on decentralization. There is a lot of new management thinking out there both in corporate settings and in developing countries which needs to be applied and could be applied with great effect.

And, indeed, part of the problem in Ethiopia and elsewhere is not only the policies and the way they have been constructed, but the way they have been managed. There is a large body of management literature which has been waiting to be fully applied to these circumstances and I would urge you to do that.

In conclusion, I would say that my focus has been on some of the practical necessities that need to be dealt with in terms of the larger questions of Ethiopian politics, in terms of policy areas, and in terms of management. I would be happy to take questions.

Senator GORE. Thank you very much. We appreciate the statement.

[The prepared statement of Mr. Harbeson follows:]

PREPARED STATEMENT OF JOHN W. HARBESON

1. Focus of this statement. I welcome this opportunity to participate in the the Joint Economic Committee's deliberations on the current status of agriculture in Ethiopia and on policies that might promote sustainable agricultural development and ameliorate food shortages within the country's very difficult political, socio-economic and environmental circumstances.

This prepared statement will center on the nature of the political, socio-economic, and environmental circumstances that impede Ethiopia's progress in agricultural development and toward food self-sufficiency. It will explain how these circumstances shape the range of the possible in promoting agricultural development at least in the short to medium term. Finally, this statement will suggest steps that Ethiopia might take both to accelerate agricultural development in the face of these limiting circumstances and to modify these circumstances themselves. It will outline how the United States might assist Ethiopia in taking these steps.

2. Relevant aspects of my background. My comments are based upon my fifteen years of experience following developments in that country, including 2 years of teaching and research at Addis Ababa University between 1973 and 1975 and short term visits averaging a little over a month apiece in 1979, 1983, and 1987. My book, The Ethiopian Transformation: The Quest for the Post-Imperial State (Westview, 1988) is the most recent comprehensive statement of my views on this general subject. My perspectives are also informed by research on the politics of rural development in other African countries and by my practical experience as a social science analyst in the Office of Rural Development and Development

Administration in the Agency for International Development from 1979 to 1982 while on leave from my university.

3. The Nature of the Problem. Ethiopia continues to be the world's poorest country in terms of per capita income ($130 in 1987). It is at or near the bottom in life expectancy (47 years), lowest in the world in per capita energy consumption, suffers the world's highest maternal mortality rates (2000 per 100,000 live births) and one of the highest infant mortality rates (155 per 1000 live births), and endures the planet's worst doctor-to-population ratios and 3rd worst nurse/population ratio. Despite great efforts particularly since 1974, Ethiopia still enrolls a smaller percentage of its school aged population than all but a handful of other countries. Daily calorie intake per person (estimated at 1749 in 1986) is well below what is considered minimal, is the lowest in the world save only Mozambique and Chad, and has declined during the 1980s. Immunization percentages for children are among the lowest on the continent.

As troubling as is Ethiopia's current economic status are the country's very weak measures of economic progress, even by comparison to other least developed countries. Despite revolutionary measures to liberate the country's economy from traditional constraints sustained by Haile Selassie and a long line of imperial predecessors, the World Bank estimates its average annual rate of GNP increase fropm 1965 to 1987 at nearly zero (0.1%). In the company of many other African countries, Ethiopia's rates of GDP growth have dropped precipitously since the mid-1970s.

Moreover, average annual GDP growth in the agricultural sector, anemic at only 1.2% between 1965 and 1980, turned sharply negative (-2.1%) between 1980 and 1987, the worst record of any least developed country save Mozambique and Sao Tome. Food aid increased tenfold between 1974 and 1987, a rate of increase exceeded by only a very few countries. One crop, coffee, accounts for a higher percentage of agricultural exports (50%) for Ethiopia than for all but three other African countries, and I have seen data suggesting that Bank's data may underestimate the country's dependence on coffee for export income. Average rates of export growth have been negative for the last two decades, and the negative change in the ratio of import to export growth over this period has been one of the world's very worst. Ethiopia's ratio of debt service to export income is worse than average, though still better than average in relation to GNP.

It may be worth noting that, at least in financial terms (dollars per capita and as a percentage of GNP), Ethiopia was roughly average in 1987 among least developed countries in levels of net development assistance received from all countries. These figures would appear to include neither military nor humanitarian assistance, both of which Ethiopia has received in abundance.

Statistical indicators of poor economic performance by themselves fail to portray the structural disarray of the Ethiopian economy, particularly in the agricultural sector which still accounts for over 40% of gross domestic product and 80% or more of employment. In common with other African countries, weak levels of agricultural development reflect apparent declines in productivity per hectare for at least some crops, a reality only

partially compensated by expanded cropping areas. These productivity declines betray the many fundamental structural weaknesses of the Ethiopian agricultural sector. There is little chance that the country will escape regular visitations of drought and famine until these weaknesses are repaired.

First, levels of investment in agricultural research and extension have been grossly inadequate to the tasks of increasing agricultural productivity. A great deal of work is needed on developing and disseminating crop varieties and cultivation technologies appropriate to chronically overcultivated, ecologically fragile lands. Moreover, the energies of extension workers have been diverted by the government from providing technical assistance for small producers to managing agrarian institutional change.

Second, land tenure inequality and insecurity, among the most fundamental agrarian ills during the regimes of the emperors, have continued to afflict producers in new forms since 1974. Quite apart from the merits of the several phases and approaches to land reform undertaken by the Mengistu regime in the last fifteen years, producers still do not have secure title to the lands they cultivate. Whatever the terms of such title should be, the problem on the ground is that they have not been clarified and codified. Moreover, a much underappreciated problem of agrarian land reform generally, not just in Ethiopia, is that to be successful it must be a continuing process, not a one shot venture. For example, the initial land reform program in 1975 sought to equalize holdings, but failure to fine tune this program to take account of demographic change quickly reintroduced land

tenure inequalities. Failure to take account of fertility differentials led to the perpetuation or reintroduction of resource inequalities. Priority for existing residents over those emigrating from other areas quickly reproduced significant inter-regional inequalities in landholding. Whatever the merits or demerits of the later phases of agrarian reform introduced by the Mengistu government, the introduction and widespread implementation of these measures has been given disproportionate priority over the consolidation of changes previously introduced. This observation applies not only to the circumstances of individual rural families but to the new institutions introduced ostensibly for their benefit: peasant associations, service cooperatives, and producer cooperatives.

Third, access to agricultural support services has been grossly unequal. In common with many other African countries, the requirements of livestock raising have been largely ignored in favor of those of agricultural production and, ipso facto, the needs of pastoralists have been heavily subordinated to those of sedentary agriculturalists. Whatever the merits and demerits of more collectivized agriculture in principle, the Mengistu government has given heavy preference to participants in the later, more collectivized phases of land reform over those in the initial more individualist phase in terms of agricultural prices, access to official markets, agricultural credit, and technical assistance. Since only a very small percentage of agrarian producers have entered the more collectivized phases of land reform, inequalities in access to production support have been very marked and have had a negative impact on productivity.

Fourth, the evidence is overwhelming that small scale agricultural producers are relatively more efficient users of scarce resources than larger scale farmers. Nevertheless, the Mengistu government has greatly extended the practice of Haile Selassie's government to concentrate agricultural development resources in large scale estates, the difference being the extent of public ownership and control of them under the Mengistu regime. These state farms have produced grain to feed the cities and the armies but at the cost of unsustainable inefficiencies and more productive resource uses foregone.

Parenthetically, I do perceive that the World Bank has sent African countries somewhat mixed signals on the question of small scale agriculture over the last decade. Its emphasis on small scale privatized agricultural enterprise in the early years of structural adjustment programming appears to have ebbed, larger scale private enterprise being increasingly acceptable particularly in such forms as joint ventures.

Fifth, it is clear that both the extent and the pace of public management of the agricultural economy has stifled producers' incentives and sapped the strength of an already weak, fragile economy. Resettlement of rural families from overworked, overcrowded northern districts to lands of better potential in the east, south, and southwest is neither new nor wrong in principle. It has long occured on a voluntary basis, and considerable NGO-sponsored small scale resettlement occured even during Haile Selassie's regime. But the scale and the pace of resettlement under the Mengistu regime greatly exceeded available domestic and

external resources, encouraging speculation about the government's political motivations.

Similarly, there is a case to be made for promoting some form of villagization in the interests of more efficient delivery of social services. But the extent and rapidity of the government's villagization initiative precluded the careful planning required to insure that these rural centers would maximally serve the interests of rural families.

Extensive, rapid villagization and settlement under heavy official pressure has been directly counterproductive to the legitimate purposes such ventures might serve. For lack of careful planning, they have proven grossly inefficient and a waste of scarce resources. Such planning should have included ensuring that the programs served the interests of the intended participants as they perceived them. Without such preparation, few households had any incentive to participate or any clue how to turn the experience to their advantage. Conversely, they have little motivation to remain, and escapism particularly on the settlement schemes has been high, further undermining the economic viability of the projects. Such unsettled conditions on the "settlement" schemes have sometimes spilled over and destabilized the surrounding communities.

Sixth, it is clear that whatever the strengths and weaknesses of western external private investment and public aid to developing countries, Ethiopia has not benefitted to the extent that it has drawn more on Soviet and eastern European assistance during the 1980s. Soviet and Cuban military assistance has indeed saved Ethiopia from defeat in the Ogaden War and at least delayed

a similar fate at the hands of Eritrean and Tigrean liberation movements. But it is almost universally recognized within Ethiopia that the country has derived little economic benefits as a Soviet client.

In early 1988, the Ethiopian government yielded to World Bank insistence upon some economic liberalization, breaking a long impasse in negotiations for a new phase of Bank assistance for agrarian development. The agreement extended to lifting restrictions on inter-regional trade in grain and a modest 7.7% increase in official grain prices. The government has implemented the agreement in good faith but has not treated it as a prelude to broader liberalization. The predicted benefits of even these modest steps have been washed away in some parts of the country by the spreading theatre of civil war.

Notwithstanding the generally very weak state of Ethiopia's economy, the country has made some progress in recent years in a few significant areas. Rates of inflation have remained relatively very low (2.6% per annum between 1980 and 1987). Though they are projected to increase, population growth rates have been moderate by developing country standards. Literacy rates have been dramatically increased since the mid-1970s as a result of determined official campaigns. Enrollment percentages of school aged populations have improved markedly, though they still are low, and educational institutions remain starved in terms of both financial and human resources. Immunization percentages for children have increased more rapidly than in many other African countries though they still remain very low. Finally, the government has shown awareness and concern for

environmental degradation in leading one of the continent's most successful, albeit limited reforestation campaigns during the 1980s.

4. Approach to understanding the problem: appraisal of causes of underdevelopment and available resources for ameliorating them. It is important to distinguish different levels of causes of Ethiopia's continuing economic stagnation, particularly in the agricultural sector. We must recognize that these causes both shape and are themselves shaped by historical circumstances that influence what the country can and cannot do in the short to medium term to improve its agrarian economy.

Some of these causes fall within the category of policy implementation. These may be more easily and more quickly alleviated than others and be quite amenable to donor-assisted reform initiatives. Some causes of agrarian stagnation may be matters of more settled policy choice whose merits can be debated and on which external donors can exert, and have exerted varying degrees of influence.

Finally, some causes of underdevelopment are historico-structural. These may include more deeply rooted problems, perhaps well recognized by a country's leaders themselves, whose amelioration can only be expected over the medium to long term, failing some sort of revolutionary transformation of the kind appearing before our eyes now in central Europe and, one hopes, Southern Africa. Such problems may need to be treated for the medium to long term as representing fundamental, settled trade offs between, on the one hand, specifically economic development interests and, on the other hand, other values rooted in the

cultural and political identity a nation seeks to preserve and/or realize. To a greater extent than for policy implementation or policy choice problems external multilateral and bilateral donors may need to accept such tradeoffs as givens in the shorter term and determine the nature and extent of their assistance accordingly.

Counterbalancing problems at these different levels are the resources --great and small, actual and potential, relatively easily and less easily mobilized-- that a country can deploy to achieve economic progress by alleviating and/or working within the framework of the recognized causes of agrarian underdevelopment. One of the major tasks of any Ethiopian government, assisted in varying measures by donors, is to recognize and deploy those resources effectively.

In the pages that follow I will undertake to (1) outline these three levels of problems bearing on Ethiopia's efforts to achieve sustainable agricultural development and (2) consider the kinds and status of resources that might be available to address them.

5. Fundamental historico-structural constraints. There are at least two fundamental issues, not easily solved in the short to medium term, that impinge negatively on prospects for agricultural and other forms of economic development in Ethiopia. These are (A) the definition of Ethiopia and (B) the purpose of Ethiopian politics.

A. The definition of Ethiopia. Perhaps the most fundamental overarching historico-structural constraint to economic recovery in Ethiopia is the unresolved question of the definition of the

Ethiopian state in the most basic "constitutional" sense of that term. In one's distress with the brutality and seeming futility of Ethiopia's civil wars, it is easy to overlook the reality that their causes are profound and not easily reconcilable. The basic issue is not the merits of official ideologies and policies nor who should rule but the very definition of the Ethiopian state itself. In this sense the contenders in the Ethiopian civil wars are fighting over an issue more basic than those present in the changes sweeping at least some of the eastern European countries today.

A cursory review of Ethiopia's modern history explains both the source of the controversy and, in my own view, suggests a possibly legitimate answer to this fundamental question. Perhaps 70% of the territory within the country's internationally assumed borders was incorporated through the conquests of Menelik II in the late 19th and early 20th centuries. The country is in many respects, therefore, an African equivalent of the now long dismantled European empires. At the same time, ethnic differences are much less sharply defined and are far more blurred than elsewhere in Africa. The peoples now incorporated within Ethiopia have historically interacted with each other since long before Menelik's conquests. They have intermingled, traded wih each other, and intermmaried. To a substantial extent they have learned each other's languages, many non-Amhara have Amharicized their names, and many non-communicants of the Ethiopian church have become such over the years. These complex patterns of integration and differentiation are repeated within each of the major commonly recognized ethnic communities. Moreover, in the

centuries before Menelik's conquests political boundaries were far less sharply defined and ebbed and flowed with the politico-military fortunes of individual rulers to a far greater extent than has been the case in the 20th century.

The problem is that recent governments have so polarized politics between and among Ethiopian communities that their differences may be irreconcilable notwithstanding their history of cultural consanguinuity. Haile Selassie systematically dismantled the carefully constructed United Nations-sanctioned Eritrean federation with Ethiopia in the 1950s. In its almost unvarying reliance upon military force to suppress the Eritrean liberation movement the Mengistu regime may have sacrificed the last opportunities for any reconciliation short of Eritrean independence. The government's almost sole reliance upon military force in dealing with the Eritrean Peoples Liberation front has proven self-defeating and counterproductive. Once supplied with arms by middle eastern countries, the EPLF has in recent years supplied itself largely with captured Ethiopian equipment. At this moment Mengistu himself has acknowledged that Ethiopian armies face the imminent prospect of final defeat in Eritrea.

The Mengistu regime's militarist approach has also spawned and fanned the fires of other liberation movements, particularly the Tigrean liberation movement which, with its allies, has made a serious bid to overthrow the Mengistu regime by equally military means. The Oromo liberation movement in the south and south west, and others elsewhere in the country have been much weaker but they appear to remain alive and well.

The Ethiopian civil wars have almost completely subsumed the country's development efforts. Well over 50% of public expenditure has been diverted to the war effort. With all deference to indications of development efforts behind the liberation fronts' lines, the same would appear to be true for them as well. The enormous expansion of the Ethiopian armed forces since the mid-1970s has withdrawn tens of thousands of the country's young from more productive efforts, not to mention the countless numbers killed in combat. Moreover, the government has in effect attempted to regiment development processes to the requirements of martial law, treating development initiatives as additional theatres of the war effort. To this observer the real motive power behind state farms, villagization, collectivization, resettlement, and market management has been at least as much the Mengistu government's equation of its own military survival with that of the Ethiopian state as it has been Marxist-Leninist ideological persuasion.

Two great adverse consequences of persistent civil wars are (1) that they will continue to drain much needed resources from development initiatives, and (2) that they will undermine the fabric of the Ethiopian state itself. At least some of the evidence suggests that there may be prerequisites for effective structural adjustment in Africa; e.g. structural adjustment reforms don't <u>create</u> the properly functioning market mechanisms they are designed to encourage; rather these must already be in place. Thus, the destructive consequences of civil wars in Ethiopia, no matter what their political and military outcomes, could well include dissolution for some time of those minimal

levels of basic social and political integration required for effectively functioning markets and reformed development programs.

An end to the civil wars, for all the reasons just explained, is a necessary condition for an economic renaissance in Ethiopia. While military campaigns obviously can influence and have influenced state transformation in Ethiopia, I am persuaded that the civil peace required for agricultural and other forms of development will not be achieved before some political consensus is reached on the structure of politics. Leaders of the Eritrean liberation movement have recognized that even an independent Eritrea will need to negotiate terms of economic and other forms of association with Ethiopia. The issue is, thus, not whether there must be negotiations but when, on what terms.

Mediation of these civil wars is essential at some stage. Identification of a suitable mediator has been a problem. United Nations arbitration would presume that Eritrea is an independent state, which the Mengistu government is obviously not yet prepared to accept. I take this opportunity to applaud the work of former President Carter in getting some of the parties together at least on procedural preliminaries to substantive negotiations and in identifying others who might be in a position to mediate substantive talks, even if they now appear to be stalled. The Soviet Union's pressure on the Mengistu government to negotiate by threatening termination of its arms agreement after 1991 has clearly helped create at least the beginnings of a climate for negotiations. The tidal waves of change in the Soviet Union and Eastern Europe cannot but have some effect the objectives and policies of all the protagonists in the Ethiopian civil wars. But

once again the fundamental issue in these wars is not only Marxism-Leninism but the political definition of Ethiopia itself.

I believe the United States can do no more and no less than to encourage all such informal efforts to bring the parties to the negotiating table and to reward success in such negotiations with new levels of development assistance. The goal of such assistance should be to reduce the extent and frequency of the need for us to provide humanitarian aid. Just beneath the surface in Ethiopia I believe there is still a deep reservoir of respect for and appreciation of the United States and of the contributions our assistance might once again make.

My own research leads me to believe that the basis for the ultimate resolution of civil war in Ethiopia is a much more federal or even confederal political system. As recently as a few weeks ago, I have heard noteworthy figures associated with both the Eritreans and the Mengistu government agree on this point in each other's presence, recognizing that such de facto decentralization is deeply rooted in Ethiopian traditions long pre-dating the reign of Haile Selassie. The issue, thus, is not whether but what kind of federal or confederal structure will emerge. The range of the possible would appear to include, at one extreme, restoration of autonomous status for Eritrea along the lines of the 1951 United Nations accord (with some increased autonomy for other regions as well), and, at the other extreme, something like a northeastern African common market of independent states, including Eritrea. In short, "regional" economic cooperation appears not to be at issue, only(!) agreement on the political framework within which it is to take place.

B. The purpose of Ethiopian politics. In our distress over the persistence and destructiveness of civil war in Ethiopia, it is easy to lose sight of a second fundamental issue which has also given rise of civil war. In the first years of the Mengistu regime before Mengistu himself consolidated his power, there was a great deal of violent struggle, particularly in Addis Ababa, over what should be the course of an Ethiopian revolution then in its infancy. The central issues were (1) whether political liberalization should precede or follow fundamental agrarian and other reforms to destroy the socio-economic foundations of the previous feudal-imperial order; and (2) whether military leadership of the revolution was appropriate or necessary even on an interim base at the outset, let alone for the next fifteen years--my position being that the trappings of civilian rule in Ethiopia in the form of the Workers Party are still just trappings, particularly at the top.

As Mengistu gained increasingly unchallenged power within the military regime, his regime succeeded in suppressing militarily those who opposed military rule, delayed civilian rule, and the inauguration of fundamental socio-economic reforms (including land reform) by an non-civilian regime--even if there was relatively little disagreement on the substance of the reforms themselves. The civil war over these issues, which lasted from late 1975 to about 1978, may have been terminated means, but the issues themselves have not been laid to rest. My research has led me to believe that they still percolate just below the surface and that were the military government of Ethiopia to fall, intense debate and possibly violent struggle would again surface over what should

be the guiding principles of Ethiopian politics. Such a debate would unavoidably include the questions of how to structure or restructure the agrarian and other sectors of the economy.

My purpose in raising this issue is to suggest that we should not necessarily expect events in Ethiopia to follow the same profound and dramatic course as they have in much of eastern Europe. It is not necessarily the case that there is a flood tide of opposition to Marxism-Leninism waiting just below the surface. The Tigrean People's Liberation Front's recent public adherence to the Albanian model serves to illustrate the point. When and if it comes, the debate may well focus as much or more on what kind of socialism to follow as on whether to adhere to socialism at all. Moreover, one cannot emphasize too strongly Ethiopians' profound sense of their own distinctive political and culture history, and any new order that might emerge in Ethiopia will surely be influenced by those roots. Even Mengistu's government has attempted to draw symbolic legitimacy from precedents set by Menelik, Johannes and Tewodros--though not, of course, Haile Selassie.

Given the importance of agriculture to Ethiopia, it is certain that agricultural policies and practices would be central to any such debate on Ethiopia's future, should a collapse of the Mengistu government make possible a resumption of the long suppressed debate on the direction and purpose of Ethiopian politics. The centrality of agriculture to Ethiopian politics will not change, only perhaps the nature and range of the debate about its course.

6. Policy Choice Constraints. A second layer of constraints on agrarian development in Ethiopia is that of the regime's policy choices on which bilateral and multilateral donors may be able to exert somewhat greater influence.

There is little dispute that economic liberalization is necessary, roughly along the lines encouraged by the World Bank in its structural adjustment programs for a number of African states; i.e. reduction or ending of price subsidies, reduced state ownership and management of the economy, and a range of measures to stimulate individual economic entrepreneurship, particularly in agriculture. In Ethiopia in particular it is generally agreed that villagization, producers cooperatives, state farms, and other forms of agrarian collectivization must at a minimum be sharply deemphasized.

I do not quarrel with these policies in general terms. The issues for me are (A) how these reforms are conceived and implemented in the circumstances of particular countries such as Ethiopia, and (B) important priorities essential to economic recovery that may tend to be overlooked in zealous delivery and implementation of standard structural adjustment packages. My comments in this section will address each of these issues.

A. The "how" of policy reform in Ethiopia. 1. "Private" land tenure. In justifiable criticism of the several forms of agrarian collectivization perpetrated by the Mengistu government, many observers have called for increased attention to the requirements of the majority of uncollectivized small producers who are presumed to enjoy or require "private" land tenure. Such statements misapprehend the situation of most rural Ethiopian

households, and it is important that advocacy of agrarian reform in Ethiopia not rest on such premises. First, such statements unacceptably simplify land tenure arrangements in Ethiopia. Traditional land tenure arrangements in Ethiopia were of enormous and only partially charted complexity. Many of the most remembered of these forms were anything but synonymous with freehold tenure in the western sense of that term. It would be a mistake to assume apriori that, left entirely to their own devices, a majority of Ethiopian households would opt for freehold.

Second, the first phase of land reform initiated in 1975, to which rural households seem broadly to have subscribed, did not establish freehold tenure. Rather, rural households were to enjoy usufructuary tenure under the jurisdiction of small peasant associations to which legal title to the lands of their constituents was assigned. Whether rural families understood the subtlety of such arrangements is debatable. However, calls for "private" tenure beg the debatable question of whether land tenure reform should be based on the 1975 proclamation or on a freehold tenure never previously ratified in Ethiopia.

Third, calls for a "return" to private agrarian land tenure in Ethiopia ignore the consequences of fifteen years of radical agrarian transformation measures in reproducing the very insecurity such measures were designed to alleviate. As important as what ultimate model is chosen for agrarian land tenure in Ethiopia, and how it is chosen, is taking steps <u>first</u> to reduce tenure insecurities by clarifying <u>existing</u> rules. Such steps should include determining the status of peasant associations

under the 1975 initial land reform for the benefit of producers not affected by settlement, villagization, or producer cooperatives. They should include dealing with the requirements of those who remain in existing settlements, villages, and producer cooperatives. Interim tenure security measures should provide for those who have abandoned these experiments in collectivization. The inequalities arising from inattention to 1975 reform in favor of greater collectivization need attention immediately. In short, more immediate than the formulation of a new agrarian land tenure system is the necessity of dealing in the interim with land tenure insecurities provoked by the rapidity and incompleteness of the Mengistu regime's reforms, the ultimate objectives of those measures notwithstanding.

2. Resettlement. The Mengistu government's draconian settlement program, implemented by forced marches, has given the term a very bad name, at least in Ethiopia. Nevertheless, in any comprehensive program to stimulate an agrarian renaissance in Ethiopia, the issue of relocation needs to be addressed. There are overcrowded areas and overcultivated lands and there are areas of good land that have been relatively less overworked. One option is to allow spontaneous individual migration such as has occured in the past. Another, however, is to establish incentives and assistance for some households to relocate in their own interests and to allow overutilized lands to be more easily reclained. It might be possible still to tap the expertise of those who organized small NGO-run settlements prior to the mid-1970s.

3. Pastoralists. I would enter a particular plea that the emphasis on reviving Ethiopian agriculture not exclude the requirements of pastoralists as has been largely the case in the country both before and since 1974. Pastoralists still represent a significant minority of the rural population, and the livestock industry is not unimportant in Ethiopia. A case in point is the Awash Valley. In the last decade of Haile Selassie's rule irrigation-based plantations were introduced with official encouragement and participation along the Awash River. These plantations displaced Afar pastoralists from some of their best grazing lands. Experimental settlement schemes for the Afar in the mid-1970s, introduced at the insistence of UNDP and FAO, provided only cash for selected Afar, labor for migrant agricultural workers and no provision for improvement livestock raising. Initial protestations by the Mengistu government to the contrary notwithstanding, these Awash settlement schemes were vastly expanded under World Bank auspices with little or no increased provision for the Afar. Only in the last two to three years has there appeared to be any serious planning for the integration of livestock with crops and for the adaptation of the Afar to such mixed farming. Comprehensive planning for pastoralists to preserve their lifestyles or partially to wholly effect their transition to sedentary agriculture has not yet been undertaken.

4. Cooperatives. Because of its association in Ethiopia with the government's objective of fully collectivized producer cooperatives, the idea of encouraging cooperatives has also been severely tainted. It is important to remember, however, that

within the context of the initial 1975 land reform, the government introduced not only peasant associations but service cooperatives. Each service cooperative was to be a conduit for marketing produce from, and providing agricultural support services to several peasant associations. Peasant associations were to hold title to land and to manage the distribution of usufructuary holdings among their constituent households.

Before the government turned its attention to other forms of collectivization in a major way, the early evidence suggested that rural households recognized the value of these forms of cooperation to their individual enteprises. It is important for reformed agricultural policy in Ethiopia to include measures to strengthen these institutions so that they realize their potential value to rural households.

5. State Farms. That the government's emphasis on state farms has been inappropriate and misplaced has been recognized by almost all observers of Ethiopia's agrarian economy. Even Soviet economic advisors offered an unusually candid memorandum to the government in 1986 in which they urged deemphasis of this and other forms of agricultural collectivization.

Criticism of the extent and pace of state farm creation has, however, left largely unaddressed the question of what to do with those that present exist. Should they be completely dismantled? Should they redesigned in some fashion? Should a few be maintained while others are dismantled? How should any liquidation of state farms be accomplished? What have been the consequences of state farm development for land conservation, and

30-597 - 0 - 90 - 2

what corrective measures if any are needed? These are among the questions that need to be addressed.

The state farms have generated a marketable surplus that has enabled the government better to supply the cities and its armed forces. In any transition away from state farms, the generation and distribution of marketable surplus must be considered. In effect, the government has relied upon state farms as a kind of surrogate for a more broadly based, effectively functioning market structure.

This observation points to the question of how to reform the whole system of agricultural marketing in Ethiopia, a subject on which I am sure others in this hearing will be more qualified to comment than am I.

This discussion of areas of agricultural policy reform prompts a word of caution concerning United States' bilateral relations with Ethiopia. Major powers' bilateral relations with Ethiopia are rendered somewhat more difficult than would otherwise be the case. The problem is that Ethiopians tend to see in their history a long record of betrayal and untrustworthiness on the part of the great powers. This includes Portugal in the 16th century, Italy and Britain in both the 19th and 20th centuries, France and Britain in this century, the Soviet Union presently (in terms of economic assistance) and the United States at the end of Haile Selassie's reign and the beginning of the post-imperial era. The United States is often seen as having let down Ethiopia in military terms, leaving the country vulnerable to a Somalia then heavily armed by its then Soviet patron. This history somewhat

counterbalances otherwise positive attitudes toward the United States described earlier.

The history of Ethiopia's bilateral relations with major powers affects possible assistance for agrarian reform more directly than might otherwise be the case because of the extent to which the regime has treated implementation of its agrarian policies as a theatre of its military struggles for political survival. And the regime has tended to equate its own survival with that of the integrity of the Ethiopian state. Justifiable or not, these "atmospherics" partially explain difficulties bilateral and multilateral donors have experienced in persuading Ethiopia to undertake policy reform.

B. The "what" of policy reform in Ethiopia. In our concern with improving agricultural performance in Ethiopia it is important that we not be so myopic as to underestimate the importance of strengthening other sectors which bear directly on the long term success of agricultural reform. Three such areas are education, health, and the environment.

Agricultural development depends on cultivation of human resources. Ethiopia has made important strides in improving educational opportunity for its citizens. However, the general impoverishment of the country has unavoidably taken a toll on the quality of education available at all levels and in all forms, including agricultural education. Similarly, famine and pestilence have inflicted enormous human costs on Ethiopia. Medical progress in Ethiopia has been very slight at best. Ethiopia requires assistance in virtually every aspect of health

care if it is to have a workforce capable of promoting and sustaining agricultural reform.

Finally, Ethiopia has been more aggressive than some African countries in some aspects of environmental restoration, such as deforestation. More effort is required, however. In addition to redoubled efforts in reforestation, much needs to be done in soil and water conservation if an Ethiopian agricultural renaissance is to be environmentally sustainable over the long term.

7. Policy Implementation Constraints. For years multilateral and bilateral donors have paid lipservice to management improvement in developing countries. But relatively rarely has such management reform actually received the emphasis it deserves. One reason for the underemphasis on management has been the extraordinary concentration on macro-economic aspects of development in both bilateral and multilateral development agencies. The oversight is unfortunate because important advances in management technology have occured in recent years, many of which have been experimentally as well as field tested both in corporate industrial and in Third World agrarian contexts.

The general outlines of improved management technology have centered on greater participation by clients as well as by agency staff in policy formation, the importance of organizations "learning" what works in the environments they serve and reorienting themselves accordingly, the value of decentralized decision-making, and the utility of more informal organization matrices as against reliance on prototypical formal hierarchies. Since it was first inaugurated by the Harvard Business School some years ago, management science has increasingly been built upon the

case method with all that implies in terms of experimentation and situational adaptation.

The relevance of the "new" management to the Ethiopian context is that many of the failures of the Mengistu regime's agrarian initiatives may be attributable to antiquated management techniques and not solely to the content of the regime's policies, the philosophies underlying them, or the designs of the institutions to effect them. It is a nice question, worthy of investigation in its own right, how far it is possible for progressive management to correct policy or basic institutional structural defects. However, my hypothesis is both that better management would have mitigated many of the ill effects of past government policies and that it will be essential to the successful implementation of agricultural reform in Ethiopia.

There is considerable evidence, for example, that although in form all the varieties of cooperatives introduced by the Mengistu government through its agrarian policies encourage participatory decision-making, there has in fact been little or none. Such associations have instead been venues for officials to tell local households what is to be done. There are many reasons why this has been the case: (1) attachment to what is taken to be essential to good Marxist-Leninist practice, (2) aspects of traditional Ethiopian political cultures, and (3) subject of these institutions to martial administration by a government engaged in what is has viewed as a desparate struggle to preserve the integrity of the Ethiopian state and its own power.

The point is that as policy reform begins to occur in Ethiopia, it is essential to support such reform with management

improvement measures whose value in successful policy implementation is sustained by an increasing body of experimental and empirical evidence.

8. What is to be done? The principal point running through this entire statement is that agrarian reform in Ethiopia, and support for it by the United States and other donors, should center on the practical requirements of such transformation. Attention should center on (1) practical necessities of cooperation between parties to the civil wars that will exist no matter what the military-political outcome of their struggles; (2) the practical requirements of policy reform notwithstanding the ideological significance such reforms may carry; and (3) the great importance of management improvement in implementing any reforms that are undertaken. I believe such a course will be most productive and beneficial in our dealings with Ethiopia.

Senator GORE. Our second witness is Paul Henze, resident consultant with the RAND Corp. We are going to—because we have to conclude the hearing prior to noon—ask the witnesses to try to keep their statements to 10 minutes.

Mr. Henze, welcome and thank you for joining us.

STATEMENT OF PAUL B. HENZE, RESIDENT CONSULTANT, RAND CORP., WASHINGTON, DC

Mr. HENZE. It is a pleasure to be here. It is a pleasure to have an opportunity to talk on a subject to which I devote a great deal of my time. When I first visited Ethiopia nearly 30 years ago I was struck by the attractiveness of the country, the productive potential of the country. I have never lost confidence in that potential.

In the intervening years I have traveled hundreds of thousands of miles through the country and last year recently visited it again, seeing a large number of resettlement sites, new villages, economic development projects, and so forth. So, what I have to say reflects that background.

I will not read my prepared statement. I would like, however, to read a one-paragraph summary and then give you a few further comments and observations.

Famine in Ethiopia is primarily the result of the authoritarian policies and oppressive methods of Mengistu's Marxist-Leninist regime. Ethiopia has the potential to be one of the most successful food-producing countries in Africa. Its potential for industrial crops and commodity exports is equally high. Though northern areas suffer from environmental degradation, which is the cumulative result of long historical processes, the country has enormous underused and untapped agricultural resources. The present regime's efforts to exploit these have been erratic and misguided. Insurgency and civil war, which have increased in intensity during the past 3 years, have been exacerbated by government actions. Development assistance provided by several European countries and international organizations has had only a marginal effect in slowing the steady decline in agricultural production. While there is good reason for the United States to explore potential development projects in Ethiopia, there is no justification for actually providing assistance until the present regime is replaced and development policies are totally reversed. Ethiopia needs a free market and incentives for private agriculture—then it will be able to feed itself and export agricultural produce.

I would like next to read a few comments that are taken from a review of Ethiopian experience and I will explain it shortly:

> [An American] eyewitness of revolutionary events . . . quite explicitly characterized the agrarian reforms of the military government [Derg] as an effort of the new regime to establish absolute political control of peasantry. In our view he correctly believed that to solve its agrarian problems, the country should develop small-scale farms. In spite of accomplishments postulated in party documents, the Ethiopian leadership has still not succeeded even in approaching a solution of the problems of economic development, national integration, raising the living standards of the masses, and their genuine inclusion in the political process. The country is undergoing an economic crisis. . . . [R]eliance on political and administrative actions rather than on economic production incentives and material self-interest . . . led to disruption of normal farming activity of millions of peasants and to the constant threat of famine.

Economic and social crisis, the danger that millions of people will perish from hunger, the formation of a political system in which the population is in practice removed from the adoption of decisions, and prolonged unsuccessful war against separatism create the ground for opposition activity . . . widespread coercion of the peasants in the process of establishing consolidated farms. Obviously, the experience of similar transformations in several other African countries was insufficiently analyzed. . . . Not only the degree of readiness of the peasants for cooperative production, but the ability of the state to materially support cooperative production was obviously exaggerated. The peasants preferred their own traditional methods of farming and were skeptical about collective forms of labor. . . . The announced principle of voluntary entry into a cooperative was negated by regulation [stating] that in case of leaving or being expelled from a cooperative, land, agricultural implements, and entry fees would not be returned to the peasant, while compensation would be paid only if it suited the needs of the cooperative.

That is a measure of the kind of coercive spirit that has prevailed in Ethiopia.

Now, a final selection from these quotations, and this will reveal to you where they come from:

Likewise, I experience with collectivization of agriculture as a result of which the peasantry was ruined and the problem of production was sharply exacerbated—millions of people died of hunger and our country was transformed from an exporter into a major importer of food—is in no way appropriate in . . . African countries (and has nothing to do with social progress in general).

These quotations all come from an article that appeared about a year ago in a major Soviet magazine devoted to the Third World.[1] And they demonstrate what we see in Ethiopia over a period of several years now: a very sharp criticism of the Ethiopian Government's policies and practices by the Soviet Union itself. The pressure on the Ethiopian regime to reform has been very steady, extensive, and substantial, and the Soviets have actually said almost all the things that the World Bank, the European nations, and our own critics, as well as Ethiopian specialists, have said about agriculture in Ethiopia. So, the problem in Ethiopia today is not trying to figure out what needs to be done, not trying to analyze the situation; it is perfectly clear that things are in an atrocious mess. The problem is the regime itself.

For a long period of time I felt that the problem probably was to get the regime to reform. But today, given what has happened in the world and given the kind of policies that the Ethiopian regime continues to pursue, I am inclined to think that very little can be done in Ethiopia as I said in my summary and as I say in my prepared statement, until the regime itself is replaced. And that is why I welcome this hearing, because I think if we go on every 2 or 3 years going through this orgy of famine relief that we conduct in most admirable fashion, the mobilization that the United States leads and that the rest of the world participates in, to get food to hungry people in Ethiopia is really one of the more remarkable developments of the late 20th century.

But what we have to do to deliver food is go to enormous lengths to argue with the bureaucrats and Addis Ababa who try to block it. There are several ways to overcome the various inefficiencies and deal with the complications that arise in dealing within certain or-

[1] See G.A. Krylova, "Natsional'no-demokraticheskaya revolyutsiya v svete novogo politicheskogo myshleniya (na primere Efiopii)" (National-Democratic Revolution in the Light of New Political Thinking [The Example of Ethiopia])", *Narody Azii i Afriki*, No. 1, 1989, pp. 42–53.

ganizations which are sometimes cooperative and sometimes not. We usually succeed. We succeeded in 1984, 1985, and 1986. We succeeded again in 1987 and 1988. Our prospects for success, I think, are a little more complicated at the present time, but on each occasion after we succeeded we have, in effect, walked away from the problem. This it seems to me is the area where corrective action is most urgently needed.

I want to make a few more comments specific to the Ethiopian situation. I comment on these in my prepared statement. One of the most serious problems is that this regime has been a particularly dogmatic Marxist-Leninist regime that wants to organize everybody in the country in a tight system with no opportunity whatsoever in terms of the expression of popular will. It is the antithesis of democracy. Ethiopians don't have a long history of practicing democracy, but there are many forms of traditional consultation and many forms of cooperation that have been undermined by the present regime. Nothing has undermined them more than the villagization process, the business of herding peasants into huge military camp-style villages. It threatens to undermine the entire fabric of Ethiopian agriculture and the basic ability of the country to feed itself in the most elementary sense.

Other factors, such as prices and procurement systems have been equally disadvantageous. War, yes, war is a problem, but war is not an accident of nature. War is a direct result, as my colleague John Harbeson has stated, of bad policies on the part of the regime, of authoritarian methods and a willingness to support continued efforts to suppress dissident elements by arms.

And one final comment here, as critical as some Soviets have been of Ethiopian agriculture and economic policies, they have continued to pour arms into the country. Our best estimates are that 11 billion dollars' worth of arms have gone into Ethiopia in the last 13 years. Wars could not continue if the arms didn't come. The degradation that resulted from wars would not have happened if there were not weapons there for people to fight with.

At the present time the Ethiopian insurgents and the Ethiopian Government are both, in effect, supplied by the Soviets. This is another area where I think American policy needs to move to a new level. We need to engage vigorously in a program for persuading the Soviets, and if not persuading then shaming them, into limiting this continual arms flow. Nothing would be more advantageous in the whole Horn of Africa than an arms moratorium and a general cease-fire.

Thank you.

[The prepared statement of Mr. Henze, together with an attached address, follows:]

PREPARED STATEMENT OF PAUL B. HENZE

STARVATION IN A POTENTIAL BREADBASKET

Agriculture in Marxist Ethiopia

SUMMARY

Famine in Ethiopia is primarily the result of the authoritarian policies and oppressive methods of Mengistu's Marxist-Leninist regime. Ethiopia has the potential to be one of the most successful food-producing countries in Africa. Its potential for industrial crops and commodity exports is equally high. Though northern areas suffer from environmental degradation, which is the cumulative result of long historical processes, the country has enormous underused and untapped agricultural resources. The present regime's efforts to exploit these have been erratic and misguided. Insurgency and civil war, which have increased in intensity during the past three years, have been exacerbated by government actions. Development assistance provided by several European countries and international organizations has had only a marginal effect in slowing the steady decline in agricultural production. While there is good reason for the U.S. to explore potential development projects in Ethiopia, there is no justification for actually providing assistance until the present regime is replaced and development policies are totally reversed. Ethiopia needs a free market and incentives for private agriculture--then it will be able to feed itself and export agricultural produce.

THE ROAD TO DISASTER

Ethiopia is the second most populous country in sub-Saharan Africa. The World Bank estimates its population at 49 million in 1990 and projects a population of 66 million in the year 2000. In spite of famine and a persistent low standard of living under the best of circumstances, the country's population has been growing at the rate of 2.9 percent per year and is not expected to slow down during the next ten years.

During the most recent decade for which complete data are available, 1979-1988, food production in Ethiopia declined from an annual per capita average of almost 200 kilograms to less than 125 kilograms. These are the most fundamental facts about Ethiopia's current predicament: **inexorably rising population** and **steadily declining food production**. The not surprising result is **chronic famine**. Is Ethiopia the victim of nature? Not at all. It is the victim of dogmatic Marxism-Leninism.

At least 85 percent of Ethiopia's population is engaged in agriculture. Agriculture accounts for almost half of the country's GDP. Ninety percent of the country's declining exports are provided by agriculture. A single crop, coffee, regularly accounts for almost two thirds of Ethiopia's export earnings. **Rational expansion of agricultural production should, therefore, be central to any government's program for modernization and economic development.** The pre-revolutionary government and foreign donors reached this conclusion in the 1960s, and policy was based on it.

Before the 1974 revolution which resulted in seizure of power by a Marxist-Leninist military junta, Ethiopia was one of the more promising countries in Africa. During the five years preceding the revolution, GDP grew at an average rate of 4.5 percent annually, reaching a peak of 6.8 percent in 1970. Agriculture grew more slowly than industry and services, but averaged 2 percent annually. Private commercial farms were expanding rapidly and peasant agriculture in areas selected for intensive development efforts by Western donors was making excellent progress. The government was giving higher priority to agricultural expansion than it had previously enjoyed and prospects for significant increases in production as a result, *inter alia*, of application of Green Revolution technology, were considered excellent.

The revolutionary junta (commonly known as the Derg) decreed nationalization of all land in 1975 and introduced an egalitarian system under which all peasants were entitled to a minimal allocation of land to cultivate as long as they belonged to peasant associations. Initially the response to the new land tenure system was positive in the

center and south of the country, but less so in the north where land nationalization and other socialist "reforms" provoked widespread resistance which rapidly developed into serious insurgency. All private commercial farms were nationalized and most were turned into state farms on the Soviet model. Little investment was made in agriculture and what there was went almost entirely to state farms and a few hastily organized model collective farms. Nevertheless, during the first years following the revolution, the country experienced no serious shortage of food. Production of industrial crops and commodities for export declined sharply, however, and to this day has never approached pre-revolutionary levels.

In 1981 the Derg announced its intention to restructure Ethiopian agriculture on a full Soviet model. By this time the fact that peasants did not own the land they cultivated was discouraging investment and permanent improvements. Farmers found that peasant associations functioned as government administrative arms rather than as their own instruments. Increasingly peasants retreated into producing for their own consumption and not for the market because government price controls and forced delivery quotas discouraged expansion of cultivated areas or efforts to increase yields. Meager supplies of improved seeds, fertilizers, pesticides, and agricultural implements were allocated to state and collective farms. Crop failures and severe food shortages plagued northern regions in 1982 and 1983. The Great Famine of 1984 did not occur without warning. **And though drought was a contributing factor, it did not cause the famine.**

Dawit Wolde Giorgis, who was in charge of the famine relief operation until he defected in October 1986, documents in *Red Tears*[1] how callously Mengistu ignored the famine and concentrated on elaborate ceremonies for launching his communist-style party in the fall of 1984. When Western media broke the news, the famine became a worldwide concern. Though millions of people were displaced and tens of thousands died, the famine was overcome during the next two years by the efforts

[1]Red Sea Press, Trenton, NJ, 1989.

of the United States and its friends and allies. As a result of the famine, Ethiopian specialists, Western donors, and even the Soviets recommended far-reaching reforms not only in agriculture but in economic policy in all respects.[2]

Mengistu's response was to ignore recommendations for reform and concentrate on two coercive campaigns designed to lock Ethiopian agriculture into a tight communist-style system: villagization and resettlement. Since 1985, approximately 15 million peasants have been coerced into tearing down their homesteads and moving to dismal grid-style "villages" which resemble (and are often referred to by the peasants themselves as) camps. Great promises of amenities were made. Except in a few showpiece villages, none has materialized. The villages were clearly envisioned by Mengistu and the narrow clique of ideologues who support him as the first stage toward Soviet-style *kolkhozes*. Their main immediate appeal was as a device to control peasant movement and facilitate extraction of crops.' Over the medium and longer term these "villages" threaten to undermine the whole structure of Ethiopian peasant agriculture, for young people find life in them distasteful and lose their desire to continue farming at all.[3]

In spite of all the favoritism they have enjoyed, state farms have been unprofitable. They are overloaded with bureaucrats and employees hired for political reasons. They constitute a net drain on the national budget, though they provide food for Mengistu's armies.

More immediately drastic in its negative consequences but affecting far fewer people was the resettlement program launched in late 1985. It was initially supported by the Russians, who provided trucks and planes to transport destitute and often ill famine victims from northern camps

---

[2]See my *Ethiopia: Crisis of a Marxist Economy. Analysis and Text of a Soviet Report*, The RAND Corporation, R-3677-USDP, Santa Monica, CA, April 1989.

[3]I have described some of these villages and the problems they create in reports of travels in the Ethiopian countryside in recent years, e.g., *Ethiopia: Contrasts and Contradictions*, The RAND Corporation, P-7389, Santa Monica, CA, October 1987; and *Ethiopia in early 1989--Deepening Crisis*, The RAND Corporation, P-7574, Santa Monica, CA, November 1989.

to lowland sites in the western and southern regions of the country where they were dumped into hastily organized state farms. Mortality at some of these sites reached 30 percent and none could have proved even temporarily viable if foreign relief organizations had not come to the rescue with food, supplies, and medical assistance. **Almost 600,000 people had been moved by the time the program was suspended in 1987** and the Russians distanced themselves from it. Alone among Western donors, Italy undertook a massive commitment to support a resettlement site called Pawe in Gojjam, to which over 100,000 people were originally sent. As of mid-1989, Italy had spent $270 million developing this site. The 80,000 people in it have nevertheless not yet approached self-sufficiency. When I visited it a few months ago, it was under attack by insurgents, people were fleeing from it at a rate of several hundred per month, and Italians in charge were having difficulty justifying continued expenditure to their own parliament.

A still confidential report which Mengistu has never acknowledged, prepared by a high-level Ethiopian commission in 1988, recommended drastic overhaul and/or abandonment of most resettlement sites and revealed that as of that time the Ethiopian government had spent almost $300 million of its own resources on them. Western donors taken together have probably spent twice that amount. **This money, put into supporting peasant agriculture, could have produced significant increases in food production of benefit to the whole country.** A Marxist-Leninist lust to regiment and control people plus misguided intellectual notions of how economic development can work must be at least part of the explanation of the Ethiopian regime's addiction to concepts such as resettlement and villagization and stubborn persistence in maintaining them in the face of failure.

As Mengistu's government has fallen into deep crisis during the past year, its control in the countryside has weakened. In many areas, the new villages are dissolving. In large parts of the north where there is no government presence left (e.g., the whole province of Tigre and much of Eritrea), the countryside has reverted to traditional subsistence patterns. It is in areas such as these--chronically subject

to drought--that famine has again developed, as it did in 1987-1988. Peasants cannot apply age-old strategies for coping with disaster. They become apathetic and retreat into a posture of simply waiting for things to change. Without fundamental policy changes, prospects for the 1990s are dismal.[4]

Vast amounts of evidence attest to the failures of the Ethiopian regime's approach to agriculture. **Some of the best of it has been produced by Ethiopian specialists in Ethiopia**, men who work at the Institute of Development Studies of Addis Ababa University, for example, and technicians working for the government. There is no shortage of good ideas and studies on Ethiopian rural development.

UNREALIZED POTENTIAL

To obfuscate the negative consequences of its own policies, the Ethiopian regime has grossly exaggerated drought and environmental degradation as causes of the country's food difficulties. Well-meaning people in Ethiopia and abroad have accepted and keep repeating data and statistics that cannot be substantiated. Figures on deforestation alleged to have occurred over the past 40 to 50 years are a good example.[5] **Erosion and soil exhaustion are indeed serious in northern parts of the country**. Programs for dealing with them were accelerating at the time of the revolution. Mengistu's determination to suppress resistance and dissent by military means has kept the north in turmoil for the past 15 years. Thus, almost nothing has been done to alleviate these problems and they have worsened.

Drought is not a new phenomenon in northern and eastern Ethiopia. It has been a fact of life since time immemorial. People living in these areas developed strategies for coping with adverse conditions.

---

[4]The projections I made a year and a half ago which were dismissed by the regime at the time as unjustified have turned out to be understatements of the seriousness of the situation. See *Ethiopia's Economic Prospects for the 1990s*, The RAND Corporation, N-2857-USDP, Santa Monica, CA, February 1989.

[5]See the introduction to Christopher Clapham, *Transformation and Continuity in Revolutionary Ethiopia*, Cambridge University Press, 1988.

Villagization, restrictions on labor movement, discriminatory pricing policies, prohibition of trade in agricultural commodities, restrictions on movement of livestock, and refusal of the government to make elementary services available to the private farmers have all hampered peasants and discouraged them from taking responsibility for their own fate.[6] **Ethiopia's transport network is adequate, if the government assigns the task priority, to transport food from surplus-producing regions to regions of crop failure**--a practice that takes place in all countries, even the United States. Kenya coped successfully with a drought in 1985-1986 far more serious than conditions that have affected Ethiopia and suffered no famine at all.

Numerous estimates made over many years' time have concluded that no more than 15 percent of the cultivable land in Ethiopia is being utilized. One only has to travel through the western provinces of Wollega, Illubabor, and Kaffa, areas which almost always enjoy good rainfall, to see confirmation of these estimates. Instead of providing incentives for private settlers and commercial agriculture in such regions, Mengistu dumped hundreds of thousands of destitute famine victims into resettlement sites. **Fear of private initiative and free markets has driven Ethiopia's Marxist-Leninists to treat the country's peasantry as serfs to be regimented rather than as human beings who will respond rationally to opportunities to better their lives and serve their nation's interest at the same time.**

Only 3 to 4 percent of land suitable for **irrigation** has been utilized, though Ethiopia possesses potential for irrigated agriculture unequalled in Africa. Addicted to Marxist gigantomania, the regime has neglected encouraging local authorities to help themselves by building small dams, ponds, and other water-management facilities. Even where plans have been developed, resources have been so limited--**with up to**

[6]A recently completed comprehensive study, based on extensive surveys on the ground in northern Shoa and Wollo, by Ethiopia's most eminent geographer and specialist on famine, Mesfin Wolde Mariam, provides impressive evidence of the effect of authoritarian governmental interference which has critically reduced farmers' capacity to cope with adversity.

70 percent of the government's budget now going for military and security expenditures--that the most elementary requirements for supporting such initiatives cannot be met.

Until recently both domestic and foreign **private investment** have been discouraged. The country has almost unlimited potential for development of agro-industry: fruit and vegetable processing, meat processing (Ethiopia still has the largest livestock population in Africa), development of wood-working, and textile production. Recently the regime has been trying to entice investors to develop projects of this kind. Confidence in the regime is so low that, not surprisingly, **no significant domestic or foreign investment has materialized.**

For years, the regime tried to nationalize **coffee production,** forcing peasants into collectives and favoring state farms while discriminating against the small, independent coffee grower. Under EEC pressure, policy on coffee was changed two years ago. Private farmers are now encouraged and have been exempted from villagization. Rigid delivery restrictions and price controls, however, still inhibit coffee production. Ethiopia never fills its international quota while tens of thousands of tons of the country's high-quality coffee goes illicitly over the borders to Somalia, Djibouti, and Sudan, all of whom export it though they grow little or none themselves. The same is true of livestock: enormous herds find their way over the borders into Somalia from where they are exported to the Arabian Peninsula. **Over the past decade more than half of Ethiopia's foreign trade, and a great deal of domestic commerce as well, is estimated to have gone underground.** It produces no revenue for the government and sustains a growing class of illegal operators. They alleviate the population's hardships by making at least a minimum of scarce goods available, including consumer goods imported from Korea, Hong Kong, and Taiwan, but at the cost of spreading corruption among government officials. A promising country's economy cannot really flourish on the basis of the black market. If commerce were freed, and entrepreneurs were permitted to exercise their skills for the benefit of society as a whole, they and everyone else would benefit.

In sum, not only agriculture, but the entire Ethiopian economy, presents a picture of frustrated opportunities, unrealized potential, and time lost which will require extra effort to regain even when the present regime has become an unpleasant memory.

WHAT IS TO BE DONE?

The revolutions in the communist world which have accelerated steadily during recent months are unreported in Ethiopian regime media. *Glasnost* and *perestroika* are forbidden terms in the Ethiopian press. The Ethiopian population nevertheless knows that far-reaching changes are taking place because everyone listens to VOA, BBC, and other foreign radio stations, and Western magazines are eagerly read. With his back against the wall as a famine perhaps even worse than that of 1984-1985 looms, and with his swollen armies suffering continual setbacks, Mengistu has become desperate. He has recently proposed sending a high-level delegation to Washington to discuss restructuring of the economy with the World Bank and U.S. officials. Such a delegation will do no harm, but it is unnecessary. For years his own technicians and specialists, Western officials and donors, NGOs providing emergency relief, and even the Soviets have been urging very specific and well-thought-out reforms on Mengistu and his clique.[7] They have remained arrogant, stubborn, sullen. They are not convincing to their own people even if they now try to pose as favoring reform. Their approach to reform is still likely to be a minimalist one. They are simply trying to hold onto power a little longer. Not only new policies but new leaders are needed to make the new policies credible and implement them enthusiastically. The country still has a few factors in its favor. E.g., compared to Eastern Europe, inflation is low and the currency has real value. The Ethiopian birr is considerably stronger than the Soviet

[7]For analysis of a recent harsh Soviet critique of Mengistu's policies and performance, see *Glasnost About Building Socialism in Ethiopia: Analysis of a Critical Soviet Article*, The RAND Corporation, N-3022-USDP, forthcoming; also a briefer analysis of the same critique, "Glasnost About Building Socialism in Ethiopia," in *Report on the USSR*, 1/41, Radio Liberty, Munich, October 13, 1989.

ruble. There are still honest and competent officials in key positions and many skilled specialists. In spite of some of the insurgents' claims, Ethiopia as a country is worth preserving. Its people are talented and know how to work, as exile performance demonstrates. Ethiopia is a coherent economic unit and could come to play a major role in Africa as well as serve as a food and agro-industry supplier to the Middle East.

But there is no case to be made for investing in Ethiopia until it has a rational government and no justification for providing grant aid or loans except under the most stringent conditions for performance and avoidance of support of any of the Marxist-Leninist policies the present regime has been following.

While the West has fed and clothed the victims of the wars that have ravaged Ethiopia--and other Horn countries--for the past decade and a half, the Soviet Union has continued to pour in arms. Through 1988 ACDA estimates indicate that the Soviets have provided Ethiopia almost $11 billion in military aid. **In 1989 alone preliminary estimates indicate that another $800 million in military supplies were delivered by Moscow to Ethiopia.** Increasingly, Soviet arms have been sustaining **all sides** in the fighting, because the demoralized Ethiopian armed forces lose control of much of the materiel they acquire, and it falls into the hands of their opponents. This makes no sense from the viewpoint of anyone's strategic interest. Under the guise of being kind to Gorbachev, the United States and its allies have raised this issue only in the most guarded terms, and seldom. **The time has come to challenge Gorbachev to an arms moratorium in Ethiopia and to enlist his participation in a coordinated international effort to bring about change in the country's leadership.**

Or, are we going to go on indefinitely making enormous exertions to save the lives of Ethiopian famine victims and then do nothing--as before--to make their lives really worth living?

ETHIOPIA AND THE CHALLENGE OF LIBERATION

Paul B. Henze

Address to a symposium sponsored by Eritreans for Peace and Democracy (EPD)

Crowne Plaza Marriott
Crystal City
Arlington, Virginia

March 10, 1990

ETHIOPIA AND THE CHALLENGE OF LIBERATION

LESSONS FROM THE RECENT PAST

Far from coming to an end, history has suddenly accelerated. The pace during the past year has been dizzying. Journalists cannot keep up with events. Publishers are caught with outdated books in their presses. As yet, processes of change show little sign of slowing. Change brings further change. The Communist World has been most deeply affected because history there had been frozen for so long, but South Africa and other countries are changing too. In the late 20th century, the whole world interacts. Nicaragua has just liberated itself, but the dead hand of Marxism-Leninism still hold several countries in its grip: China, North Korea, Vietnam, Albania, Cuba. They cannot be held back for long, for change is infectious and totalitarian communism has become an inherently unstable condition. Ethiopia has begun its escape from this arrogant philosophy of stagnation. So, it seems, have South Yemen and Mongolia. Everywhere Marxists are on the defensive, as current elections in the Soviet Union demonstrate. How much longer are Lenin statues going to stand anywhere?

What conclusions can we draw from this recent rush of history?

1. The most obvious is that *Marxism-Leninism doesn't work*, either politically or economically. It is the grand failure of the 20th century. States dominated by it have proved brittle. The longer a Marxist-Leninist system remains in power, the greater the damage it does. Where there is a potential for ethnic strain, Marxism-Leninism exacerbates it. The Ethiopian Revolution of 1974 offered the possibility of a more open society, accelerated economic development and social change, cultural freedom, and vastly expanded opportunities for individuals to manage their own lives. All this was frustrated when the Derg forced Marxism-Leninism upon the country.

2. The effects of the worldwide electronic revolution of the last two decades are irreversible. No society can be kept isolated from the outside world. Information technology makes rigid authoritarianism impossible. People cannot be forced to believe what their conscience and experience tell them is untrue. Mengistu has never been able to deceive Ethiopians.
3. State-managed economies lose momentum, waste resources, stagnate and decline. A country's foreign trade suffers. Its citizens begin to starve. In the fast-moving world of the late 20th century, time lost through economic mismanagement cannot easily be regained. The economic reforms Mengistu has just announced were long overdue, but they are unconvincing without basic political change.
4. No matter how many weapons foreign suppliers are willing to provide, military means cannot settle ethnic, regional, or social conflicts. Eleven billion dollars worth of Soviet weaponry have brought the Ethiopian state to the verge of disintegration.
5. Democratic political and economic systems, on the other hand, *do* work. They have produced unprecedented gains for their citizens. Democratic economic and political systems work not because they are perfect, but because they are *flexible*. They are self-correcting. Even the most powerful computers most intelligently programmed cannot replace the free market as the best means of regulating and stimulating economic activity. With all their imperfections, political systems based on free elections that produce peaceful change in leadership and policies have proven superior to all other forms of governmental organization.

A great variety of subsidiary lessons can be drawn from the five conclusions above. Let us leave them for later discussion and turn to characteristics of the future we are now entering. Here we are in a more speculative realm, but several of these trends are already operative.

A NEW ERA

The last great world imperial system, the Soviet Russian Empire, *cannot survive* for long. If what remains of it after the convulsions that are now engulfing it have eased is a smaller Russia, or a federation of Russian and non-Russian states, it will need decades to deal with its own problems and satisfy its citizens' desires for modernization and prosperity. The more democratic the successor states to the Soviet Empire are, the less likely they are to seek hegemony in the outer world, especially the Third World, in which most Russians have little intrinsic interest. They will have more than enough to occupy them close to home reconstructing their relations with Eastern and Western Europe, the Middle East, China and the countries of the Pacific Rim. So the world of the 1990s and the first decades of the 21st century is likely to be a much *less tense and competitive* world. "Superpower competition," an exaggerated concept even in its heyday, is already a thing of the past. All this leads to serious conclusions for the Third World:

1. For Africa, Latin America and Asia the capitalism-vs.-communism game has run its course. It can no longer be played successfully. Threats to embrace a rival or join another ideological camp are no longer effective. Third World countries must seek support on their own merits. Attempts to play Free World countries against each other are unlikely to be successful, for the framework for Free World cooperation vis-a-vis the Third World is already well established and works well. Third World countries are unlikely to have much success sheltering under the wing of any major power in order to defy other major powers or neighbors.
2. Third World countries are going to find it increasingly difficult to find sources of military support to intimidate neighbors or suppress internal disaffection. Disaffected populations will likewise find it increasingly difficult to gain military support and must find other means of expressing

their grievances. Within a few years, a total moratorium on military transfers from the developed world to the Third World is conceivable.

3. Third World priority for economic aid and investment is falling fast, though needs are rising. The needs of Eastern Europe and the nations of the Soviet Empire are so great, and some of the opportunities so attractive, that international organizations, OECD governments, and Free World businessmen are shifting their focus from the Third World. No Third World country can expect to receive aid and investment simply because it can demonstrate a need. It must make itself attractive in a much more competitive situation. It must adopt realistic development policies. It must demonstrate that it can manage its economy effectively. It must ensure conditions that appeal to foreign investors, for much of the assistance that Third World countries can expect from the developed world will, *increasingly*, be in the form of private investment and bank loans, not government-to-government grants. Third World countries which encourage vigorous and innovative private entrepreneurs and a healthy, open private economic sector will gain an advantage over others.
4. Continuity of investment conditions, economic predictability and political stability will be more important than ever before in determining aid, loan and investment decisions in developing countries. Countries which cannot manage their politics effectively will suffer economically. Social conditions will also be increasingly important as a consideration given weight by foreign investors. The manner in which a country operates its educational system and encourages development of skilled technical and managerial manpower will be a determining factor in many investment and loan decisions.
5. The agricultural sector in most Third World countries is not only a crucial factor for their own internal development, but has a direct relationship to their international standing.

They must quickly expand their capacity to feed their growing populations and simultaneously increase production of commodities for export and raw materials for domestic industry. Most Third World countries have mismanaged and discriminated against their agriculture, and none more appallingly than those applying Marxism-Leninism. The more rapidly a country corrects bad agricultural policies, the more likely it will be able to recover economically and become attractive for foreign aid and investment.

6. *Economic cooperation* on a very comprehensive basis, with emphasis on free trade and progressive economic integration, is the hallmark of modern capitalism. U.S. and Canada are integrating economically. The European Economic Community is consolidating and expanding. Eastern Europe will soon join it. There are similar developments on a smaller scale throughout the world. Third World countries that pursue autarkic economic policies are condemning themselves to lag behind. The underground economy in much of Africa--and especially in the Horn region--stands in sharp contrast to the policies and practices of governments. The underground economy should be permitted to rise to the surface and lessons derived from it applied to policy. The entrepreneurship and free trade spirit it reflects can then operate to the direct benefit of everyone. Governments will gain revenue that can be applied to accelerated social and economic development.
7. Successful economies require an open labor market and unrestricted movement of manpower. Attempts by Marxist governments to control manpower have wasted it and slowed development. Basic human rights considerations will increasingly require that governments limit restrictions on the activities and movements of their populations to those required for the common benefit. Human rights have become a permanent international concern.

8. *Economic flexibility* and *freedom* go hand in hand with political openness and pluralism. Neither can be fully effective without the other. States without democratic experience can expect to be given time and help in setting up viable, self-sustaining political systems but they will not be excused for retrogressing into dictatorship and totalitarianism. Federalism offers one of the most practical formulas for training in, and exercise of, responsible government. Several of the most successful states in the modern world operate on the federal principle: the U.S., the German Federal Republic, Switzerland. The experience of India demonstrates that federalism can also serve as an effective political basis for a developing society. Marxism has paid lip service to federalism, but its totalitarian ideology has prevented it from operating in practice. Thus the Ethiopian Marxist regime's efforts to establish autonomous administrative regions have never been convincing to the people they were supposed to benefit.

THE BURDEN OF HISTORY

I am not going to say much about history, for I am bored by the rancorous historical debates that I hear between proponents of Ethiopia's territorial integrity and separatist and dissident movements, and often among separatists and dissidents as well. Ethiopia has more history than most of Africa so there is more to argue about, but the level of argumentation is often low or legalistic and there is a good deal of mythology on all sides. Every country's history includes mythology which is often entertaining and exploitable for purposes of art and tourism, but if leaders base policies and actions on it they impair their ability to make rational decisions.

History is best applied *pragmatically*, for we are in a pragmatic era of history, which is going to continue well into the 21st century. Unlike most of Africa, Ethiopia has a real history, parts of which are still in the process of being uncovered and most of which is continually

subject to reinterpretation. This can be a constructive process. Ethiopia's history gives the country status in the world community that few other Third World countries possess. It also gives it a basis for cohesion as a modern state. Most African states lack these advantages. They should not be discarded lightly simply because an ignorant leader, operating in the name of *Ityopya Tikdem* and Marxism, has brought the country closer to disintegration than it has been at any time in the past 120 years. In a world where political flexibility and economic creativity are recognized as criteria for judging a country's support-worthiness, Ethiopia still has a potential for evolution into a polity that can ensure prosperity, peace and opportunities for development for all its peoples.

There are obviously both positive and negative features in Ethiopia's past. I am puzzled by many of the partisan views and much of the conventional wisdom I hear about Ethiopia. If the state is simply an Amhara conspiracy against the rest of the people who inhabit it, why have the inhabitants of Wag, Lasta, Saynt, Gaynt, Semyen, Manz and Jirru remained at such a low level of economic and political development? Why are they now such strong opponents of a regime that is often characterized as Amhara-dominated? If the vast southern regions brought into the Empire by Menelik II suffered such deep alienation from it, why have they generated so little resistance to the Marxist regime? If northerners find Amhara and Oromo so unappealing, why have so many Eritreans and Tigreans migrated southward, and why do they continue to take advantage of opportunities to participate in government, professions and trade throughout the country?

What I see when I visit Ethiopia, even in its present dire straits, does not correspond with the picture that Ethiopians in exile often paint of a country that has no rationale for existence. All the considerations relating to the future that I have discussed in the first two sections of this essay and all the challenges that Third World countries face in the current historic era seem to me to offer opportunities upon which a reconstructed Ethiopian state is better positioned to capitalize than the majority of countries of the Third World.

ETHIOPIA REFORMED AND REVIVED

Mengistu's Marxism has done so much *internal* damage to the country that drastic and far-reaching domestic reforms and concessions must be made if the positive features of the state are to be preserved. On the other hand, from the viewpoint of international law, international organizations and the country's diplomatic standing, relatively little permanent harm has been done. Addis Ababa remains the capital of Africa and Ethiopia, in contrast to its present government, has prestige on the continent. It has other strengths as well: e.g. the monetary and banking system has been more successfully maintained than in most Marxist countries. Many autonomous state corporations and educational institutions function efficiently, are capable of providing dependable service throughout the country and can be extended and expanded: Ethiopian Airlines, the highway authority, the telecommunications administration and postal system; the universities and specialized training and research institutions. The existence of these institutions improves prospects for recovery from Marxism. They make Ethiopia as a country far more appealing as a recipient of sustained support, assistance, investment and help and advice of many kinds than separate parts of it, fragmented, could possibly be. These are not simply theoretical or sentimental considerations--*they are important pragmatic facts*. Emotional political activists and insurgents with no experience in governing or in international relations can ignore them only at the expense of causing the people whose interests they claim to represent additional confusion and suffering.

But how can an effective government and territorial integrity be reestablished a country that has been ravaged by brutality and irrationality of many kinds and has thus partially lost confidence in itself? *A loose federal structure is the only practical solution*. The structure may have to be so loose that it remains partly fictional until alienated regions and peoples recognize advantages in cooperating with a central government that provides services and support instead of issuing orders and making demands upon them. A post-Mengistu government will have no alternative to making national reconciliation its highest

political priority and set in motion a procedure--which could, but need not, take years--whereby the country can be reconstructed as a genuine federal republic. First of all, the post-Mengistu administration must give priority to setting the economy free. In desperation Mengistu has been forced to recognize this necessity but his reforms are partial and the capacity of his weakened government to create the confidence and administrative conditions necessary for the population to take advantage of them is doubtful.

Post-Mengistu leaders will be wise to encourage responsible exercise of many other freedoms: of religion; of residence and movement; of press and assembly; of distribution of books and magazines; of unrestricted import of cultural and educational materials; of use of any languages people prefer for communication with neither favoritism nor discrimination. Ethiopians should have freedom to organize for all but antisocial and conspiratorial purposes. Widely recognized international charters and agreements, to which Ethiopia subscribed many years ago (and some of which Ethiopians even helped write), provide examples of guidelines and principles to be proclaimed and applied.

SEPARATISM AND FRAGMENTATION

There are so few examples in recent times of the collapse or fragmentation of long established states that precedents to examine are hard to find. It is nevertheless conceivable that governmental authority in Ethiopia could collapse and the country could break up into separate regions, some declaring their independence and others degenerating into anarchy. Parts of the north appear to be in this condition already. Eritrean movements have long proclaimed establishment of an independent state as their goal. They have roots that go back into the imperial era and have been by far the most successful of the armed insurgencies that have multiplied in recent years. In fact, much of the recent success of the TPLF and OLF appears to be the result of EPLF support. Though under control of its home province for more than a year, the TPLF, according to most available reports, has not created an effective government there. Reports of the

ideological positions of its leadership are disquieting. Leaders who still espouse Stalinist Marxism and hold up Albania as a model to emulate have poor prospects for creating a viable economy in Tigre or playing a constructive role in a rejuvenated Ethiopian state.

The EPLF, on the other hand, appears to have developed an effective in administration in portions of Eritrea it controls. It has gradually shed its Marxism. How thoroughly it has shed its authoritarianism is not yet clear, but recent declarations of policy give evidence that its leaders understand the significance of the revolutions that have taken place and are continuing in the Soviet-dominated world. They may have learned lessons from China as well. If Mengistu's position in Eritrea continues to deteriorate, the EPLF may be able to take control of the entire province. Will it then declare independence? Evidence of its leaders' intentions is mixed. They are wise to be weighing the implications of their actions carefully.

An independent Eritrea could not exist in a vacuum. No country, even those who have at various points provided major support for the Eritrean movement, has ever granted recognition. The Eritrean movement has never been recognized by the OAU or the UN and its chances appear no better now than in the past. Prospects for existence as a protectorate of an Arab or communist state--which once appeared realistic to some Eritrean leaders--have dimmed to the point of irrelevance. No Western government has shown willingness to serve as patron or guarantor of an independent Eritrea.

Whatever arguments are used to justify Eritrean independence, fundamental facts of geography and historical affinity are inescapable. The prospect of precarious independence next door to an Ethiopia which sooner or later is likely to experience rejuvenation (as it always has in the past) would seem, on the basis of any rational calculation, to be less rewarding than the advantages of active engagement in Ethiopian affairs in the framework of a redefined relationship to the Ethiopian state. Eritrea has geographic advantages, infrastructure, agricultural and industrial base, and talent that put it ahead of any comparable region in the Horn of Africa in the competition for investment and

economic development. It also has a natural potential to exercise a progressive influence on political and social development of other parts of the Horn, but much more so in respect to Ethiopia than Sudan or Somalia.

What is Eritrea's most logical market and source of raw materials? Where is its best source of additional labor? Where can its surplus technical and professional talent find the most comfortable and rewarding employment opportunities? In what context is Eritrea going to find it easiest to attract economic aid and investment? Through what channels can Eritrea most effectively protect its regional interests in the international arena? Independence requires a financial system, currency, legal and administrative relationships with a great many international organizations; it requires transport, communications and legal systems. Creation of these services is costly, complicated and time-consuming. What rewards, other than emotional satisfaction, can Eritrea gain from going alone in such endeavors? Eritreans are well advised to be reflecting honestly and pragmatically on all these questions.

The internal political and economic order in Eritrea is likely, no matter how things work out in the Horn, to be primarily a matter for Eritreans themselves to decide. Addis Ababa does not have the power to dictate to Eritreans. But which Eritreans will make decisions? How? These are questions with serious practical implications. Eritrea has existed in a state of siege for more than 20 years. Its people are impatient for peace. They deserve to enjoy rapid economic development and improved social services, and all the advantages of an open and freer existence. Only accelerated economic development can make this possible. But Eritreans do not want an Eritrean dictator to replace Mengistu. They will be intolerant of politicians who put their own interests above common concerns.

The help Eritrea will need to satisfy its peoples' needs will come only if conditions in Eritrea are attractive to investors and lenders. Eritrean society, whether the province becomes independent or remains affiliated with the Ethiopian state, must emerge from the isolation in

which it has existed since the 1950s. It is a segmented and fragmented society, crisscrossed by ethnic, linguistic, and religious distinctions and varied styles of life. EPLF claims that all these actual and potential cleavages have been overcome in the course of the struggle against Addis Ababa oppression are not convincing. If absolute social and political harmony prevails, and continues to prevail, in Eritrea, it is *an exception to all other human experience*. If the EPLF frees Eritrea, it must meet the challenge of establishing a flexible, non-dogmatic political, economic and social system within which tensions can be controlled and reduced. It must ensure an acceptable degree of genuine democracy and guarantee elementary human rights for all inhabitants of Eritrea. Otherwise the EPLF will be regarded as a failure.

An economically, socially and politically healthy Eritrea will have a positive effect on Ethiopia as a whole. A flourishing, successful Ethiopia is essential for peace and progress in the entire African Horn and Red Sea region. The responsibility for reaching these goals rests with the people of the region. They will receive outside help only if they demonstrate initiative, intelligence, responsibility and foresight themselves.

Senator GORE. We tend to define our relationship with the Soviet Union in terms of bilateral issues, strategic issues, human rights issues, and regional issues. And yet, Ethiopia is never seen as a regional issue in the first rank of priority in the relationship between the United States and the Soviet Union. I think that ought to change. And with the new thinking trumpted by President Gorbachev, there is actually some basis for hope that a fresh analysis within the Soviet Union, not only of the causes of the agricultural policy failure might be possible, but also a fresh analysis of the Soviet Union's role in hoping to continue the war and violence that has been such a contributing factor. I think that is very useful. We will come back to this, but let me introduce the third witness on this panel, Raymond Copson, specialist in international relations with the Congressional Research Service. I said, actually, that my first entry on a sustained basis in this field was with Ivan Tillem and Mickey Leland, but actually some years before that I had endeavored to figure out ways in which the world might anticipate and predict famine conditions and preposition relief efforts. And it was in that effort and I encountered Raymond Copson. So, we have worked together for some time on this. I look forward to your testimony today.

Please proceed.

STATEMENT OF RAYMOND W. COPSON, SPECIALIST IN INTERNATIONAL RELATIONS, CONGRESSIONAL RESEARCH SERVICE, LIBRARY OF CONGRESS

Mr. COPSON. Thank you, Mr. Chairman. I welcome the opportunity to appear this morning. I will begin with a few comments on the disastrous effects of Africa's wars on agricultural production and famine relief and then give some attention to the obstacles that might stand in the way of efforts to begin an assistance program for sustainable agriculture in Ethiopia.

Recently I have had the opportunity to conduct a study on Africa's wars during the 1980's. Around the continent during that decade, in several of the largest countries with the greatest development potential, including Ethiopia, war imposed a heavy burden on millions of people and became an insurmountable obstacle to economic growth. It may be that 3 million people or more died as a result of Africa's wars over the past decade. As a group it was probably——

Senator GORE. Could you give me that figure again?

Mr. COPSON. Three million or more. And, of course, it is impossible to come to an accurate——

Senator GORE. No, no, that's fine.

Mr. COPSON. If you look at Sudan, Mozambique, and Ethiopia, there have been significant death tolls. As a group it was probably the rural poor, who are the food producers, who suffered the most. Peasant farmers, herdsmen, nomads and their families were subjected to armed attack and forcible recruitment and saw their villages attacked, their crops destroyed and found it impossible to obtain fertilizers or market their products because of the disruption to transportation.

Senator GORE. Let me come back. I cannot let that pass without clarifying it. Three million dead in Africa's wars over the last decade. Is that indirect deaths caused by bullets and other instruments of warfare? And is the famine toll to be added on top of that?

Mr. COPSON. Most of Africa's wars occur in remote areas of remote countries. And we are dependent on the efforts of journalists, international civil servants, and others with imperfect information. But, I am speaking of deaths from combat and civilian deaths directly caused by war.

Senator GORE. But by direct cause you do not mean famine deaths attributed to the complications of war?

Mr. COPSON. I would include deaths of people in rural areas who are cut off from adequate nutrition, health care, and shelter because of war.

Senator GORE. What percentage of the 3 million would be in that subcategory? A rough estimate?

Mr. COPSON. Well, I would think the large majority, perhaps 90 percent in some wars.

Senator GORE. All right, thank you. Go ahead.

Mr. COPSON. In every case where you see a famine in Africa it is really a war that has turned the food shortage arising initially from drought or some other cause into famine. Once food shortages begin to appear in a wartime situation, the delivery of relief aid is vastly complicated. Both sides may use food as a weapon, governments may give priority at port and airfields to the delivery of military equipment. War can contribute to a breakdown in civil authority, allowing corruption and the diversion of food aid for private purposes to flourish. Finally, war impoverishes countries, taking away the spiritual and material resources that they might need to restore peace.

The war in Ethiopia is one of the most serious in Africa, ranking in terms of mortality perhaps second only to the war in Sudan. As the events now unfolding in Ethiopia move forward, it could be that the Ethiopian conflict will become the most serious of Africa's wars in terms of mortality. There are thought to be 4 or 5 million people in northern Ethiopia who today are under threat of famine. The Eritrean port of Massawa was the principal entry point for the relief aid for these people. Consequently, if that port remains out of action as it is right now, the human consequences could be very grave indeed.

Despite Ethiopia's problems or really because of them, the country has received substantial economic assistance from around the world. I have a small table in my prepared statement looking at 1986 and 1987. In 1986, for example, over $800 million in economic assistance came into Ethiopia from a variety of donors. Mostly this was aid for development rather than for relief. But that was not true of American assistance, which has been focused on relief. You may ask how Ethiopia could absorb such a large quantity of aid in view of the war that is underway there, but at least up until recently the worst of the fighting was confined to a land area of about 20 percent of Ethiopia's total with perhaps 20 percent or less of Ethiopia's population. So, there were other parts of the country where development activities could take place. Nevertheless, war

has been a threat elsewhere. Guerrilla bands in northwestern Ethiopia, for example, have forced the Italians to scale back a large integrated development project around Lake Tana.

Assessing the impact of the development aid going to Ethiopia is difficult. The World Bank's aggregate data are not very encouraging. They show overall economic growth of 0.9 percent between 1980 and 1987 when population was growing at 3.1 percent. However, some donors seem to have positive expectations for growth prospects in Ethiopia. The World Bank itself, for example, has given aid for Ethiopian agriculture and referred positively to the reform minded agricultural-development policies of the Government.

Nonetheless, many observers remain skeptical of the prospects for development in Ethiopia because of the turmoil there. In addition, they question the depth of the Government's commitment to economic reform. The World Bank's program is small for a country of Ethiopia's size and would probably be expanded if the Government went further in the direction of reform.

I will speak for a moment about United States assistance to Ethiopia. During the 1950's and 1960's, Ethiopia was the closest ally of the United States in sub-Saharan Africa, and the leading recipient of United States foreign assistance. United States relations with Ethiopia deteriorated for a variety of reasons after the 1974 revolution. The graph that I have in my prepared statement shows how our military assistance and development assistance dwindled away to nothing by 1979, and food aid then became the only sort of United States aid to Ethiopia. This aid has been credited with saving many thousands of lives, and it is a very substantial program. In some years, Ethiopia has once again been our leading recipient of aid in Africa because of the large quantity of food aid.

Those who see a case for becoming involved in agricultural development in Ethiopia might note that there are still fertile parts of the country outside the war zones where aid could be beneficial for capital-short peasants. They might also argue that such aid would strengthen the reputation of the United States as a friend of Ethiopia's people. Critics on the other hand could point to the deterioration of security over a large part of the country, the potential for political instability, and the doubts over the Government's economic reform policy.

Ethiopia has sought an improvement in relations with the United States, with the hope of seeing the United States aid program restored. At times, officials in Washington and Addis Ababa have spoken positively of the prospects of improved relations. United States officials continue to insist, however, that better relations would require progress toward peace in Ethiopia, greater respect for human rights there as well as further economic reforms.

There are some legislative obstacles to any program to support sustainable agriculture in Ethiopia. One of these is the Brooke amendment, which prohibits aid under major assistance programs to countries more than 1 year in default on principal and interest payments on loans from the United States.

Ethiopia overall is about $100 million in debt to the United States, but only about $5.8 million of this appears to fall under the terms of the Brooke amendment as in default. This matter arises from a dispute over some military sales to Ethiopia during the

1970's. So, the Brooke amendment problem might well be resolved if improvement in relations began to seem possible.

The African Development Foundation is a possible vehicle for assistance in Ethiopia, despite the Brooke amendment. The Foundation does not appear to be covered by Brooke, but it has no current plans to become involved in Ethiopia. There are other legislative provisions regarding human rights, aid to Communist countries, and aid to Ethiopia in particular, which may cause problems, but they have explicit waiver provisions or otherwise allow for aid to the neediest people in the recipient countries. In any case, the President has blanket authority to waive such provisions under section 614 of the Foreign Assistance Act. So, the current obstacles today supporting sustainable agriculture in Ethiopia are primarily political rather than legal obstacles. The launching of an aid program awaits the resolution of political problems rather than alteration of the legislative provisions.

[The prepared statement of Mr. Copson follows:]

PREPARED STATEMENT OF RAYMOND W. COPSON

Mr. Chairman, thank you for offering me the opportunity to appear this morning. My name is Raymond W. Copson, and I am a Specialist in International Relations with the Congressional Research Service of the Library of Congress. I appear in response to the Committee's invitation. I intend to begin with a few comments on the disastrous effects of Africa's wars on agricultural production and famine relief in general. I will then give some attention to Ethiopia's war and to the economic assistance that has continued to flow to Ethiopia despite the fighting. Next, I will briefly review the history of U.S. assistance to Ethiopia and discuss the obstacles that might stand in the way of efforts to launch an assistance program in support of sustainable agriculture in Ethiopia. I conclude with a short assessment of the prospects for renewing U.S. development aid, including aid for sustainable agriculture.

Recently, I have had the opportunity to conduct a study of Africa's wars, their causes, and their costs. Around the African continent during the 1980s, in several of the largest countries with the greatest development potential, including Ethiopia, war imposed a heavy burden on millions of people and became an insurmountable obstacle to economic growth. It may be that 3 million people or more died as a result of Africa's wars over the past decade. Overall, some 9 to 12 million Africans were made homeless by war, becoming refugees or displaced persons. As a group, it was probably the rural poor, who are the food producers, who suffered the most. Peasant farmers, herdsmen, nomads and their families were subjected to armed attack and forcible recruitment. Often, they saw their means of making a living

destroyed as villages were attacked and crops destroyed. If food producers avoided this fate, the breakdown in transportation that accompanies war made it difficult for them to obtain fertilizers and other inputs to production, and prospects for delivering food to markets were sharply diminished.

Once food shortages began to appear in wartime situations, ongoing conflict vastly complicated the delivery of relief -- turning shortages into famine. Governments and resistance movements sometimes used food as a weapon, keeping relief supplies away from populations perceived as hostile and diverting them for the use of armed forces and militia. In some instances, relief convoys were attacked by one side or another, while governments typically gave priority at ports and airfields for the landing of military equipment rather than famine relief. War contributed to a breakdown in civil authority, allowing corruption and the diversion of food aid for private purposes to flourish. The parties to conflicts became suspicious of international relief workers, who could affect international opinion with their reports on the hungry and the homeless, so that these courageous workers become subject to threats and expulsion. Finally, war impoverished the afflicted countries in many ways, depriving them of the spiritual and material resources needed to restore peace.

The war in Ethiopia is one of the most serious in Africa, probably ranking second only to the war in Sudan in terms of mortality. Conceivably, it will become the worst of Africa's wars in this regard -- once the momentous events now underway have played themselves out. Most estimates of battlefield deaths and civilian mortality resulting from the Ethiopian war run

between 500,000 and 1 million. With the intensified fighting in recent months, and the grave situation that has developed for civilians in the war zones of northern Ethiopia, a much larger human toll now seems likely.

The famine situation now emerging was triggered by the failure of rains in northern Ethiopia in 1989, but it has been made immensely worse by war. Relief agencies estimate that there are 4 million to 5 million people in northern Ethiopia today who are now under threat of famine. Of these, perhaps 3.5 million are in Eritrea and Tigray; the Eritrean port of Massawa was the principal entry point for most of the famine relief that might have been delivered to them. Press reports indicate that this port may now be out of operation. Most of the remainder of the endangered people are in Wollo province, where guerrilla forces made important gains in 1989, and the possibilities for delivering famine relief to these people appear slim indeed.

Role of Foreign Assistance

Ethiopia's grave economic problems, particularly in food production -- and the attention these problems have received around the world -- have made Ethiopia a major recipient of assistance from bilateral and multilateral aid donors. Much of this aid in the form of relief, but many donors have attempted to promote development in Ethiopia, including development in sustainable agriculture. The accompanying table indicates that the country received more than $800 million in aid in 1986, making it the fourth largest recipient in sub-Saharan Africa in that year. Aid declined somewhat in 1987, but Ethiopia remained among the top ten African recipients. In 1986, about

9 percent of Ethiopia's aid was for emergency relief, but in 1987 -- a good year for food production -- only 2 percent was relief aid while nearly all of the remainder went to development purposes. Assistance from the United States, however, was exclusively for relief purposes during in both years.

Aid to Ethiopia[1]
(Official Development Assistance, commitments)

	1986	1987
TOTAL	808.3	784.4
Selected donors		
Italy	160.7	256.1
Other European Community	144.6	226.9
United States[2]	130.9	11:4
Canada	19.4	27.8
African Development Fund	55.7	24.2
World Bank	112.5	46.0
U.N. Agencies	95.9	110.5

The ability of Ethiopia to absorb such a large quantity of aid may appear unusual in view of the warfare that has been raging in the country for years. However, the most heavily afflicted provinces -- Eritrea, Tigray, and Wollo -- comprise less than 20 percent of Ethiopia's land area, with 20 percent or less of its population. Consequently, donors have been able to implement development programs and projects elsewhere in the country despite the war.

[1]Organization for Economic Cooperation and Development. Geographical Distribution of Financial Flows to Developing Countries, 1984/1987. Paris, 1989.

[2]These figures are higher than those reported in some other sources, evidently because shipping costs of food aid are included.

Nonetheless, guerrillas representing the main resistance forces as well as fringe groups are active in the north outside the main war zones and in western Ethiopia. Their activities are a threat to development projects. Italy, for example, has been forced to scale back a large irrigation and integrated development scheme in the Lake Tana area because of guerrilla operations in the area. Recently, resistance forces have penetrated into Shoa province, where the capital itself is located, and any future expansion of their operations could have serious consequences for donor activities.

Assessing the impact of the development aid going to Ethiopia would be a difficult task in view of the war and restrictions on travel within Ethiopia. Aggregate economic data do not show significant gains. The World Bank has listed Ethiopia as the world's poorest country since 1985, and the Bank reports overall economic growth of 0.9 percent annually between 1980 and 1987, a figure that means a sharp decline in per capita income, since population is growing a 3.1 percent per year. Agricultural production fell at an annual rate of 2.1 percent annually between 1980 and 1987.[3]

Nonetheless, some donors evidently have positive expectations for growth prospects in Ethiopia. The World Bank's International Development Association (IDA), for example, committed $85 million in 1989 in support of what it termed "the government's reform minded agricultural-development

---

[3]World Bank. World Development Report, 1989. Washington, 1989. p. 166.

program."[4] The Bank is also supporting projects in education, transportation, and energy.[5]

Some observers, however, remain skeptical of the prospects for development in Ethiopia, in part because of the turmoil there and because they doubt the depth of the government's commitment to economic reform. Inappropriate, Marxist-oriented economic policies were an impediment to development in Ethiopia in the years after the revolution, but the government began to take some steps toward economic reform, including efforts to strengthen the private farming sector, in the second half of the 1980s. Whether these tentative steps will lead to far-reaching policy change, however, is in question among donors. Even the World Bank's program is small for a country of Ethiopia's size, and it would probably be expanded if the regime went farther in the direction of reform. The International Monetary Fund (IMF) has not yet sponsored a large-scale structural adjustment program in Ethiopia, intended to support government reform programs, as it has in many other countries of Africa. It is expected, however, that the Ethiopian government will soon approach the IMF with an economic reform proposal in the hope of attracting IMF support.

---

[4]The World Bank Annual Report, 1989. Washington, 1989. p. 140.

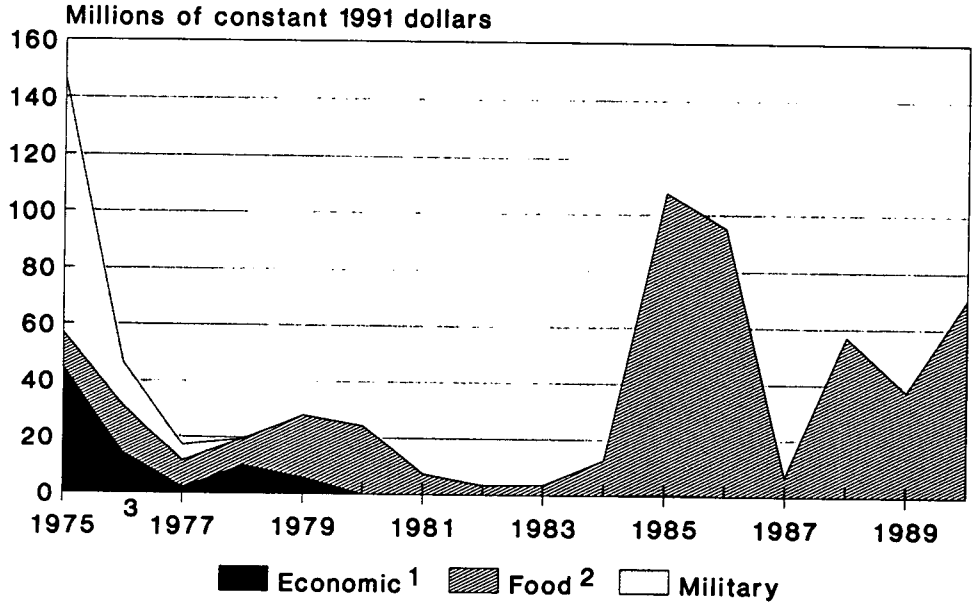
[5]On Bank policy, see Jonathan E. Sanford. World Bank Activities in Ethiopia. Congressional Research Service, Library of Congress. CRS Report No. 87-857 F.

U.S. Assistance to Ethiopia

During the 1950s and 1960s, Ethiopia was the closet ally of the United States in sub-Saharan Africa and the leading African recipient of U.S. foreign assistance. Ethiopia's strategic location on the southern flank of the Middle East gave it considerable importance in the eyes of defense planners. Many Americans lived and worked in Ethiopia in one capacity or another and came away deeply impressed with the country's development potential, its natural beauty, and its ancient culture. At the same time, many Ethiopians lived and studied in the United States, deepening the ties between the two countries.

U.S. relations with Ethiopia deteriorated, however, after the 1974 revolution. The revolutionary economic policies of the new regime; the 1977 closure of the Kagnew communications facility operated by the United States in Asmara; the 1978 Soviet/Ethiopia alliance; and Ethiopia's request for the recall of the U.S. Ambassador in 1980 -- all created an environment in which a normal foreign aid program could not be sustained. Consequently, apart from food aid, U.S. assistance dwindled to nothing by 1979 (see Figure, below). Nonetheless, the food aid program has been a highly significant one, and it contributed to the saving of many thousands of lives in the 1984-1985 famine and when famine recurred in 1987-1988. In these periods, Ethiopia became a leading recipient of U.S. aid in Africa despite the strains between the two governments.

U.S. Assistance to Ethiopia



Source: U.S. Agency for International Development publications.

1. Largely Development Assistance (DA), some Peace Corps.
2. Not including shipping costs after FY 1981.
3. 1976 includes Transition Quarter.

Those who favor a resumption of a U.S. development assistance program in Ethiopia might argue that there are fertile parts of the country, outside the war zones, where aid could be beneficial. Capital-short peasant farmers might be helped to obtain the critically needed inputs to production, boosting Ethiopia's agricultural output and economic growth. In addition, the reputation of the United States as a friend of Ethiopia's people, already strong as a result of past ties and famine relief, would be enhanced. Critics who doubt the utility of such a program, however, could point to the deterioration of security over widening areas of Ethiopia, the potential for political instability in the capital, and doubts over the government's economic policies to argue that development aid given in Ethiopia would likely be wasted. From this perspective, the United States could best show its friendship for the Ethiopian people by waiting for the overthrow of the current regime before restoring a development assistance program.

Ethiopia has sought an improvement in relations with the United States, presumably in the hope of seeing the U.S. aid program restored. Ethiopia's cooperation during August 1989 in the search for the downed plane carrying Representative Leland and other Americans led U.S. officials to express hopes for resolving the issues that have divided the two countries. But Ethiopia's proposal to restore diplomatic relations to the ambassadorial level has not been accepted. U.S. officials insist that better relations would require progress toward peace and toward greater respect for human rights within Ethiopia as well as further economic reforms.

Legislative obstacles to supporting sustainable agriculture. Apart from the policy differences between the United States and Ethiopia, there are some legislative provisions that could hamper any effort to provide U.S. assistance, apart from food aid, to Ethiopia. The most serious of these is the "Brooke Amendment," which is now found as Section 518 of the Foreign Operations Appropriation (P.L. 101-167).[6] This provision prohibits aid under the Act -- which funds Development Assistance, the Economic Support Fund, and Military Assistance, among other programs -- to countries more than one year in default on principal and interest payments on loans from the United States.

Ethiopia owes the United States approximately $100 million,[7] including outstanding loans from the Korean War period when Ethiopia was a military ally. Of this amount, principal and interest payments overdue for 90 days or more amount to $21.6 million, but only about $5.8 million appears to fall under the terms of the Brooke Amendment. This arrearage, arising from a dispute over whether or not Ethiopia had paid in advance for certain military equipment,[8] has been owed to the Defense Department since 1979. Conceivably, it could be resolved if an improvement in relations seemed

---

[6]Another provision, Section 620(q) of the Foreign Assistance Act (P.L. 87-195, as amended), prohibits aid under that Act to countries more than 6 months in default. This provision may, however, be waived by the President if he determines that doing so is in the national interest.

[7]U.S. Department of the Treasury. Office of the Assistant Secretary for International Affairs. Status of Active Foreign Credits of the United States Government, June 30, 1989. Washington. 1989. p. 3.

[8]Africa Research Bulletin, August 1-31, 1980. p. 5785. At the time, Ethiopia claimed that the United States owed it money for undelivered weapons.

possible. As a general rule, according to the U.S. Department of Commerce, Ethiopia "continues to pay its creditors promptly."[9] Ethiopia would be eligible for the African debt forgiveness program launched by President Bush if it came to terms with the IMF or the World Bank on an economic restructuring program.[10]

The African Development Foundation is a possible vehicle for assistance in Ethiopia, despite the Brooke Amendment, although the Foundation has no current plans to fund projects there. The Foundation's appropriation is made under the Foreign Operations Appropriations Act, but it is an independent agency created by Congress to promote small-scale, local development and self-help projects in Africa (P.L. 96-533, Title V). The Brooke Amendment evidently applies only to direct assistance and not to indirect assistance provided by the United States to independent organizations and then given to a particular country. The Amendment does not apply, for example, to aid from the World Bank to Ethiopia, even though the U.S. contribution to the Bank is funded under the Foreign Operations Appropriations. Section 548 of the Appropriation prohibits indirect assistance to several named countries, but Ethiopia is not among them. If Congress had intended to prevent indirect aid to Ethiopia, it would presumably have listed it in this section.

---

[9]U.S. Department of Commerce. Foreign Economic Trends and Their Implications for the United States: Ethiopia. Washington, July 1989. p. 6.

[10]Section 572 of the Foreign Operations Appropriations Act of 1989 permits the forgiveness of principal and interest due in FY 1990 and FY 1991 for least developed countries that have come to terms with the Fund or the Bank.

Section 116 of the Foreign Assistance Act prohibits Development Assistance to the government of any country engaged in a consistent pattern of gross violations of human rights, posing a potential problem for proposals to give this type of aid Ethiopia. However, the provision allows an exception in the case of aid that would "directly benefit the needy people in such country." Most sustainable agriculture projects would no doubt fall under this exception. Section 620(f) of the same act prohibits assistance under the Act -- again including Development Assistance, Economic Support Fund aid, and Military Assistance -- to any Communist country, but does not specifically list Ethiopia as such a country. The provision states that the ban is not limited to the named countries, and some might object to aiding Ethiopia under the covered programs on the ground that it is a Communist country. Nonetheless, since Ethiopia is not named, the executive branch has considerable leeway in interpreting this provision. It may also be waived by the President under certain circumstances.

Section 541 of the current Foreign Operations Appropriation prohibits assistance for any costs associated with forced resettlement or villagization in Ethiopia. An aid program for sustainable agriculture, consequently, would have to be designed to avoid any taint of association with these activities. Finally, Section 812(3)(d) of the 1985 Foreign Assistance authorization, imposed a suspension of assistance to Ethiopia because of the failure of the Ethiopian government to responsibly ameliorate famine conditions. This provision is still in force, but it specifically exempts economic assistance that would benefit needy people.

The President has the authority to waive the Brooke Amendment and any other restrictions noted here under the general waiver authority given him in Section 614 of the Foreign Assistance Act. He is not likely to exercise this authority, however, as long as U.S. policy toward Ethiopia is unchanged.

Prospects for supporting sustainable agriculture. The obstacles to launching an economic development program to promote sustainable agriculture in Ethiopia would appear to be primarily political rather than legal. If U.S. policy differences with Ethiopia on issues related to peace, human rights, and Ethiopia's economic policies were resolved -- or if the executive branch decided to ignore those differences in order to get an aid program underway -- then the legislative obstacles to aid would probably soon disappear. Improved relations might make it possible to settle the question of Ethiopia's outstanding debts to the United States, removing the legislative obstacle imposed by the Brooke Amendment. Alternatively, the executive branch could reach a political decision to waive the Brooke Amendment. Other relevant legislative provisions allow considerable room for maneuver and do not appear to constitute insurmountable obstacles to aiding Ethiopia, if a policy decision to offer such aid were made.

If these political steps are not taken, however, and the Brooke Amendment continues to apply, the principal potential sources of economic aid to Ethiopia, the Development Assistance Program, and the Economic Support Fund, will be unavailable -- barring legislative action to create some sort of exception for Ethiopia. Assistance could be provided by the African Development Foundation without congressional or executive action, but as

noted the Foundation has no current plans to become involved in Ethiopia. The widening war in Ethiopia could be an increasingly serious obstacle to potential Foundation activities, even if it wanted to become involved. In any event, while the Foundation is an independent agency, it is funded by Congress and its board is appointed by the President. One must ask, consequently, whether it would wish to sponsor activities in Ethiopia if doing so could be seen as contrary to U.S. policy.

In short, the creation of an economic aid program for sustainable agriculture projects in Ethiopia would depend more on easing the political obstacles, rather than the legal obstacles, to such assistance.

Senator GORE. Thank you very much. Those are three excellent statements and a good panel to start with.

Before asking my questions, let me invite each of you to make any brief comments that you wish to make about the presentations of the other two. Do you have any comments that you would like to make or critiques or supplements that apply to what you have heard from your fellow panelists.

Mr. HARBESON. Could I just take a little issue with my friend and colleague, Paul Henze, about Mengistu. I don't think that change in the regime by itself is going to solve anything. I think that the issues are larger than that. As I say in my prepared statement, the issues are still here regardless of who is in power.

I also, I think, would quarrel a little bit on the question about the intentions. I don't carry any brief for this particular ruler, but I do think that some of the causes of the conflict are structural, and those are the factors that really cause the problem regardless of what Mengistu's private intentions were. Other than that, I am ready for questions.

Senator GORE. Mr. Henze.

Mr. HENZE. The essence of political leadership is realism. We have seen in Ethiopia an extraordinarily unrealistic leadership that thought that Marxism-Leninism and a close relationship with the Soviet Union, following Soviet patterns, would lead to a real burst of development in Ethiopia. It became apparent very rapidly that this is not the case. This leadership has had enormous difficulty facing up to the fact the system it chose will not work.

Now, I agree with John Harbeson in one respect, and that is that in Ethiopia except up at the top, it is very difficult to find anybody that you can even talk to seriously for 5 minutes about Marxism and Leninism. Nobody believes in it. Everybody believes that it is a total disaster. Most of what I know about Ethiopia in terms of how things are working and not working, learn from Ethiopians themselves. I learn traveling around talking to people. I learn talking to the excellent Development Studies Institute at Addis Ababa University. I learn from people who are administering agriculture. I learn from people in villages and resettlement sites. What I find so impressive about Ethiopia today—and I have seen this experience often with people who have known very little about Ethiopia, but go out there—is that it is a country that still has enormous vitality.

If you look at it from a distance, people often say, "Oh, my God, it must be falling apart." But it is not. It is a country that has a great deal of spirit and it is a country that has an enormous number of talented people. The problem with the present regime is that instead of tapping that talent, using that talent, mobilizing it, they frustrate it. They frustrate it at the very lowest level.

I had the occasion just 2 weeks ago to spend several hours with a good Ethiopian friend who was here on a visit and who had just completed a 3-year study of villages of central and northern Ethiopia by sending teams around to talk to peasants about how they calculate what they want to do, how they plan, what they sell, how they manage their affairs. What is apparent from his research is that the regime's policies, particularly villagization, is hurting everybody. The regime clearly regards villages as potential collective

farms. This has had a deadening influence right down at the lowest level.

The average Ethiopian peasant today plants no more than he needs for his own immediate family and relatives, because he knows if he grows too much he is in a hassle with the Agricultural Marketing Corporation which comes and tells him that he has to deliver his quota. He ends up getting paid less than it costs him to produce. It is much better to grow just what you need. You don't worry about the people over the next hill, you don't worry about taking produce into the market and selling it. This is what the policy of the regime has led to and that is why this country, which is a potential breadbasket, is in the sad shape that it is in.

Senator GORE. Let me see if we can get some closure here on the dispute between the two of you.

You're saying, Mr. Harbeson, that the criticism leveled by Mr. Henze at the current regime is valid in its essential features, but in your view that there are structural problems which are even deeper than those to be laid at the doorstep of this regime. And you are saying, Mr. Henze, that the character of the structural problems is clearly identifiable and that they arise from the nature of the political control at the top and arise in spite of the common sense and expertise of men and women throughout the nation of Ethiopia who know how to solve the underlying structural problems. Is that the essense of your disagreement?

Mr. HARBESON. I think that is pretty close. It is not that the policies have been misguided. They have been for sure, but I think that some of the issues and problems will not go away. If the Mengistu regime left right now there would still be disputes over the basic issues that I discussed in my prepared statement. So, it is not just a question of the regime's intentions that cause the problem. It is also the fact that there are some real issues that haven't been solved yet. And that is what the wars are about.

Senator GORE. I might say that on our third panel we are going to deal with ideas for breaking the cycle, which has been characterized by the structural problems. But I take it that all three of you agree that famine is now chronic in Ethiopia, not merely the result of specialized conditions which coincidentally have arisen sometime in the last decade, but famine is now chronic but that it is not inevitable. There are reasons for believing that the cycle can be broken. Nevertheless, at the present time Ethiopia is entering yet another cycle. Do all three of you agree with that string of statements?

Mr. HENZE. Yes. Might I make a little observation? In 1984 when the great famine was getting underway, I happened to be in Ethiopia and traveled around in the center and south and visited a number of state farms where I literally walked through piles of grain. When I asked where the grain was going, I was told it was going to a new brewery nearby that had been set up to provide beer for the Armed Forces. This I think is typical of the irrational kind of decisionmaking that we have had in Ethiopia. I expect today if you could scrape all the food in the country together you would have enough food in Ethiopia to feed all people in the north who are starving. But there is no way of getting it there and there is no way of using the current government machinery to organize that kind of effort.

Senator GORE. One final effort to reach some common ground between the two of you there. If you cannot agree that the end of the Mengistu regime is sufficient, do the two of you agree that it is at least necessary? Do you agree it is necessary, Mr. Henze? Do you agree it is necessary, Mr. Harbeson?

Mr. HARBESON. I think probably yes.

Senator GORE. All right. We have some other questions for the record and Mr. Copson, several of them are directed to you. I hope that you will be able to respond in full for the record. We are going to have to move on because of the constraints of time, unfortunately. And because of a pending vote in a committee down the hall, we are going to now have a 10-minute recess, and it will be a real 10 minutes, not a rhetorical 10 minutes. And in the interim if the second panel will come to the witness table we would appreciate it. Let me again express my thanks to this panel.

[A 10-minute recess was taken.]

[The following written questions and answers were subsequently supplied for the record:]

RESPONSES OF JOHN W. HARBESON TO WRITTEN QUESTIONS

The Graduate School and University Center
of The City University of New York

Ph.D. Program in Political Science / Box 380
Graduate Center: 33 West 42 Street, New York, N.Y. 10036-8099
212 642-2355

March 18, 1990

Senator Albert Gore
Joint Economic Committee
United States Senate
Washington, D.C.

Dear Senator Gore:

I enclose the edited transcript of my oral testimony before the Joint Economic Committee session on Ethiopian agriculture that you chaired. Also enclosed are my answers to the supplemental questions you posed to the first panel. My prepared testimony can stand as is.

In the colloquy between Paul Henze and myself that your questioning stimulated, my point was simply to avoid an overly doctrinaire approach to Ethiopian problems. I do not question that liberalization of policies is required and desirable. My concern is that we encourage such liberalization with appropriate sensitivity to the empirical Ethiopian realities. It will not suffice nor help to substitute one doctrine for another.

I was very moved by your opening statement and thankful that the tragic loss of Mickey Leland and his entourage was not further compounded. I very much appreciate your interest in Ethiopia and want you to know that I remain ready and willing to be as helpful as I can to you and the committee in trying to find ways to spark an economic renaissance in Ethiopia.

Yours sincerely,

John W. Harbeson
Professor

Answers to Supplementary Questions

Panel 1

1. Necessity of Outmigration?

I defer to the agronomists and environmental specialists on this one. However, from what I know of their views over the last two decades, there is a good case to be made for some outmigration from some of the northern areas. Ethiopians themselves have made this decision, as there has been considerable voluntary outmigration over the years to the south, to the agro-industrial estates of the Awash Valley, and to the voluntary settlement schemes established by PVO groups prior to 1974.

2. Agricultural progress without an end to the war? Food as a weapon of war?.

There are two answers to the first question. In the war zones specifically, the answer is an unqualified "yes". While important efforts have been made in selected areas, the kind of wholesale reorganization of the rural economy, and the building of supporting infrastructure and support service delivery on which it depends, cannot be undertaken until there is peace. Moreover, with more than 50% of public expenditure devoted to war, the government's own resources for these initiatives are next to zero.

The second answer is that away from the war zones, some agricultural progress is possible. Here the constraints are not only the diversion of public monies to war and the

loss of workforce to the armies but the martial approach to development taken by the government. As I try to show in my book, the government has treated development as a theatre of the war effort with any reluctance to accept central government ex cathedra directives treated as passive support for regime opponents. To some extent the government's fears are justified; and to some extent they are self-fulfilling. In any event they are self-defeating. If the government could be persuaded to change its mentality, quite a bit could be accomplished even before the wars come to an end. Such a change would mean buying into new management models that are quite compatible with an approach to development that is more collaborative than the rugged individualism of classical liberalism tacitly urged presently by many bilateral and multilateral development agencies, including AID and the Bank. That would mean more participatory, decentralized management and more work on appropriate technology drawing on the local knowledge of producers themselves.

I have no direct information on the use of food as a weapon in the war, only what I have read and heard.

3. Effectiveness of Food Aid? No basis for comment.

4. Ethiopia-Kenya Comparisons in Food Supply Delivery?
One important difference is that Kenya's transport and communications infrastructure is far superior to that of

Ethiopia. Not many people one in Kenya, for example, are very far from an all weather road. By contrast, most Ethiopians still are.

5. Estimates for Ethiopian agriculture

a. Continuation of war and policies. Everything I said in answer to question 1 applies here. The longer such continuity obtains, the worse things will be and the more difficult and prolonged will be the recovery.

b. War and new policies. This appears to be the situation given recent news from Ethiopia following the hearing. As stated in question 1 above, away from the theatres of war new policies could make a considerable difference, even with loss of workforce and funds to to the war effort.

c. Peace and new policies. The best of all possible worlds for resources and workforce additions will be available. Two caveats. One, peace and privatization alone will not to the job. Many have noted how much the Mengistu regime resembles, even exaggerates the weaknesses of Haile Selassie's government that displaced. Un-trammeled privatization could produce the same result economically. I accept Dr. McCann's point that service cooperatives in fact may have been tarnished by the government's misuse of them. However, public involvement to facilitate development is essential, and

Ethiopian smallholders do accept and need some forms of cooperation in the areas of marketing, production support services, credit, and local infrastructure development.

The second caveat is that one cannot expect immediate productive miracles with peace and new policies. Some immediate progress may occur, but over the long haul it will take a great deal of assistance in management reform, infrastructural development, agricultural production service provision, appropriate technological development, and training to bring sustainable agricultural development. One of Ethiopia's advantages is that the institutional shell for such support exists in such forms as the Alemaya agrricultural training school, the Arsi development unit (formerly CADU), and the work of the Minimum Package Program now incorporated within the Bank's PADEP project.

6. Liberalization and US Aid.

The answer is yes. But this question has been overtaken by events. The recent wholesale policy changes announced should help dramatically. In this regard, I think Mengistu has seen an opening to recover, really establish, some legitimacy because of the TPLF's public adherence to the Albanian approach. We should strike while the iron is hot, looking for an opportunity to crystallize and deepen what Mengistu may think of as only a tactical reversal of course.

RESPONSES OF PAUL B. HENZE TO WRITTEN QUESTIONS

THE RAND CORPORATION

15 March 1990

Senator Albert Gore, Jr.
United States Senate
Washington, DC - 20510

Dear Senator Gore:

It was a pleasure to be able to testify before the Joint Economic Committee hearings you chaired on 27 February 1990. Thank you for your letter of appreciation and the additional questions.

I have prepared another short paper in response to these questions. In it, I take into account some of the reactions I have been getting from Ethiopia to the reforms Mengistu announced last week. Welcome as they are, people do not seem to find Mengistu's discredited government entirely credible as implementor of them. What happens now will bear close watching by the international community and the Congress as it wrestles with the problem of famine relief. Neither Mengistu's government nor the various insurgent groups is entirely guilty nor entirely blameless in this situation. We have to keep pressure on all of them.

I enclose, in addition to my comments on your questions, a talk I gave a few days ago before a meeting organized by Eritreans for Peace and Democracy in Crystal City. Unlike some of the Eritrean organizations, this one seems to be making an effort to do some fresh and relatively long-range thinking about Eritrea's--and Ethiopia's--economic problems.

I stand ready to assist your committee in the future.

Very sincerely yours,

Paul Henze

PAUL B. HENZE
Resident Consultant

Enclosures as stated.
Copy: Staff.

202·296·5000

2100 M Street NW
Washington, DC 20037-1270

Main Offices: 213·393·0411
1700 Main Street, PO Box 2138
Santa Monica, CA 90406-2138

ETHIOPIA: ENVIRONMENT, WAR, & DEVELOPMENT

Answers to Questions from the
Joint Economic Committee
U.S. Congress

Paul B. Henze

Washington, D.C.
15 March 1990

The author is a Resident Consultant at The RAND Corporation, 2100 M Street, N.W., Washington, D.C. 20037. The views and conclusions expressed in this paper are those of the author and should not be interpreted as representing those of The RAND Corporation or any of the agencies sponsoring its research.

ETHIOPIA: ENVIRONMENT, WAR, & DEVELOPMENT

Answers to Questions from the Joint Economic Committee U.S. Congress

1. What are the major environmental problems in Ethiopia and how might they best be addressed? Are some areas of Ethiopia so far beyond the local environment's ability to support the population that outmigration is necessary?

In the provinces of Eritrea, Tigre, Wollo, Gondar, northern Shoa, and parts of Gojjam, a combination of factors, some of which have been at work for hundreds of years, have caused severe environmental degradation. These include gradual deforestation, overgrazing, and soil erosion. These are obviously interrelated. The Italians initiated terracing, tree-planting and water control have been continued intermittently ever since. The United States supported terracing and tree-planting in Eritrea under food-for- work programs both before and after the revolution. During the past decade civil war in Eritrea has curtailed much of this kind of effort.

With advice and support from a variety of sources, similar programs were under way and showing progress in other parts of northern Ethiopia at the time of the revolution. In areas affected by insurgency all came to a halt. As a result, Tigre and Wollo, in particular, have suffered further environmental degradation during the past decade. On the other hand, reforestation projects I have visited recently in northern Shoa and Gojjam show progress. Some of these projects were started before the revolution, some after it.

Western, southern and eastern Ethiopia also suffer from environmental degradation, but the situation is much less severe than in the north and more rehabilitation work has continued since the revolution. For more than half a century savannah forests in semi-lowland areas have been ravaged by woodcutters and charcoalers. Commendable progress has been made in halting these activities since the

revolution, and in permitting some denuded areas to begin to regenerate their original vegetation. There has been some improvement in grazing practices.

For all its shortcomings, the Marxist-Leninist regime cannot be justifiably charged with environmental indifference. I have visited forest reserves in Shoa, Wollega, Kaffa, Bale and Arussi during the past three years and been impressed by their condition. Forestry personnel are conscientious and motivated, but the severe curtailment of budgets resulting from military demands has left little for them to work with. Considering the circumstances, national parks have been reasonably well protected. I have also been impressed in travels in many parts of Ethiopia by the increased awareness people in the countryside show of the value of preserving forests and wildlife. On the private plane, the Ethiopian Wildlife and Natural History Society has operated with remarkable vigor during recent years, facilitating communication between Ethiopians and foreigners dedicated to environmental protection and improvement.

The frequently stated allegation that Ethiopia was 40% or more forested 50 years ago but now has only 4% of its forested area left has no basis in firm evidence. It is questionable, in fact, whether there has been a great decline in forested area during recent decades, for many highland regions are judged by ecological historians never to have carried heavy forests, even in ancient times. The *blue gum eucalyptus* was introduced toward the end of the 19th century and spread rapidly throughout the highlands during the 20th century. Photographs in travel books from the last century often show barren landscape where eucalyptus now provide thick greenery. The government both before and after the revolution encouraged eucalyptus planting by providing seedlings and the tree remains extremely popular because of the variety of products it supplies: leaves and brush for kindling and shelter, poles for construction of buildings and fences, and logs that can be used for heavy construction, lumber, and firewood.

Before the revolution many Ethiopians with capital to invest bought or rented land and planted eucalyptus (and sometimes various varieties of conifers) commercially in small and large plots. The revolutionary regime confiscated all these plantings in 1975. Some have been maintained; others have been harvested or neglected. As with so many of the regime's socialist restrictions, nothing was gained by this confiscation and enterprising citizens were deterred from taking further initiative to help themselves--and thus help the country. Peasants in most parts of Ethiopia planted eucalyptus around their homesteads. The majority of these plantings have been lost as a result of villagization. This loss has not been compensated by some of the regime's socialist tree-planting schemes. Some of these may prove effective, but the planting of trees along highways, undertaken with typical socialist mass mobilization during the last few years, has been a dismal failure. Throughout northern Shoa and Gojjam last year I observed hundreds of miles of such roadside plantings in which at least 90% of the trees, all originally sheltered in little cages, were dead. Since peasants were forced to go out and plant them but they belonged to no one, no one watered or cared for the trees and the effort put into these schemes was utterly wasted. They are typical of many of the regime's ventures in "socialist construction."

I doubt that very many inhabited parts of Ethiopia are beyond environmental rescue. Considering its natural endowments, most of highland Ethiopia is less densely populated than many other parts of Africa, e.g. highland Kenya. With incentives and advice but without force, a large proportion of rural Ethiopians could be persuaded to invest their labor--and when they again have it, modest capital--in erosion control, water conservation, improvement of ground cover and reforestation. The present regime's approach to agriculture has discouraged the peasantry from even thinking in terms of improving its situation for the long term. To most peasants, villagization meant *destruction* of houses, storage structures, corrals and *abandonment* of trees (including, in some areas, coffee and ensete plantings). Peasants are unwilling to invest either labor or money in land they do not own,

for all know that regime policies were aiming at full collectivization. Changes announced by Mengistu in early March appear to reverse most policies of his regime's agricultural policies of the past 15 years. How credible these changes are, and how effectively they can be implemented, remains to be seen. Whatever happens, the fact of the changes constitutes an admission by Ethiopia's Marxist-Leninists that their agricultural policies have failed.

Forced resettlement has been such a disaster and administration of the resettlement sites established in 1984-86 such a costly and coercive undertaking that the experience has given resettlement a bad name that is likely to persist for some time. Resettlement has been carried out so as to make settlers totally dependent on government and international charity rather than encouraging self-reliance. Further resettlement is not a solution for rehabilitating people in heavily populated, famine-afflicted regions, such as Tigre and Wollo. Their lot will be more effectively improved by giving them help and incentives to improve their land and livestock and encouraging them to apply and refine age-old strategies for coping with drought.

Eventually the vast areas of semi-lowland and lowland in the west and southwest of the country can be given higher priority for development. Under free conditions, settlement of these regions is likely to continue at a modest pace if people are permitted to own land, hire labor, and are provided with elementary agricultural extension services and given incentives to grow crops suited to these regions for which there is a market either in-country or as export commodities. Individual peasants have been resettling themselves from north to south in Ethiopia over at least two millennia. Commercial farmers (whether domestic or foreign investors) know the value of attracting and keeping labor. Such operations can, over time, result in substantial voluntary population shifts.

II. Is it reasonable to talk about agricultural progress in Ethiopia until the current series of wars has ended? To what extent has food been a weapon in civil war?

Full restoration of private farming with rights to land, buying and selling of it, inheritance, free movement of labor, setting of prices for agricultural produce by market forces and everything that follows from these basic reforms will rapidly rejuvenate Ethiopian agriculture and increase food production. In contrast to the Soviet Union, Ethiopia has suffered only 15 years of socialist mismanagement of agriculture. The spirit of enterprise of the peasantry has not been destroyed. It will probably be desirable for the post-Mengistu government to enact some limitations on size of farms, minimum wages for rural labor and to set conditions under which commercial farms operate. But the fewer the controls that are retained, the more positive the response of the peasantry and of entrepreneurs is likely to be.

The reforms Mengistu has recently announced seem to meet some of these requirements, but the details are unclear and there is understandable skepticism about the government's intentions as long as any features of the Marxist-Leninist political and ideological system are retained. What is to happen to the peasant associations, e.g.? They have come to be seen as simple administrative arms of the government. Do peasants want to try to reform and retain them? How will peasant associations relate to commercial farming operations? Mengistu's government and party are not credible for the majority of Ethiopians as honest implementors of reform. Besides, Mengistu's government is steadily losing control of more of the countryside. As long as civil war continues, the full effects of even the most positive reforms are unlikely to be realized.

Agriculture continues to be relatively productive in many parts of the country that have not been affected by war: the south and east, e.g. But in these regions, too, villagization, price control, forced delivery quotas, and other kinds of government meddling have discouraged maximum production. Abandonment of restrictions and price incentives can bring a rapid upsurge of production.

In Ethiopia's civil wars--no matter what any of the parties claims--food has been and continues to be a weapon. Where, in the history of war, has food not been a weapon? The only way to stop food being used

as a weapon is to stop the wars. The first step toward stopping the wars is the get the Russians (and now the Israelis) to stop supplying weapons and ammunition.

III. Has food aid been supplied in an effective manner? Has the use of feeding stations, rather than moving the food to villages, resulted in more dislocation to local economies and migration than was necessary?

All reliable information indicates that the answer to both the above questions is yes. Famine and refugee relief operations in Ethiopia have been far more efficient, less wasteful and less corrupt than similar operations in Somalia over the past decade. In spite of indifference and obstructionism in certain parts of Mengistu's government, especially at the topmost levels, the Relief and Rehabilitation Commission (RRC) has functioned with a high degree of effectiveness.

All evidence (including extensive experience from neighboring countries: Sudan and Somalia, and from other parts of the world) indicates that feeding stations should be set up only *as a last resort in highly deteriorated situations* and should not be permitted to become permanent features of relief operations. The Kenyan experience in 1984-86 is an excellent example of how to deal with the *threat of famine* and avoid feeding stations, refugee camps, large-scale dislocation of population, disruption of families, and concomitant loss of livestock, seeds and deterioration of homesites.

IV. Comparisons have been made of Kenya and Ethiopia in terms of the effects of the 1984-85 drought. Kenya experienced a comparable drought but had less disruption of food supplies than Ethiopia and no famine. Are these comparisons fair? What accounts for the better conditions in Kenya? What changes would Ethiopia have to make to replicate the Kenyan experience?

A brief comparison of the experience of the two countries which I published in *Encounter* in 1986 provides answers to all the questions posed above. It is attached. Since that summary was published, an excellent book on the Kenyan experience, *Coping with Drought in Kenya,*

National and Local Strategies (Lynne Rienner Publishers, Boulder, CO, 1989) has appeared. In 25 chapters totalling more 400 pages, it details every aspect of the Kenyan experience. Though far more extensively affected by drought than Ethiopia, Kenya dealt so effectively with its problem that the world gives it very little credit for doing so. Effective governmental action does not produce dramatic pictures for European and American TV screens. There has been no repetition of threat of famine in Kenya since 1985, while Ethiopia went through another famine in 1987-88 and is now, in early 1990, in the grips of a famine perhaps more serious than that of the mid-1980s. Individual Ethiopians are just as intelligent and capable as individual Kenyans and Ethiopian researchers have produced excellent, detailed studies of problems associated with agriculture, drought, food production, and peasant attitudes. For the most part their government has ignored them. To replicate the Kenyan experience, Ethiopia needs an honest, non-ideological government that gives priority to the basic needs of its people and respects their right to economic freedom. The people and the government will then, together, create conditions where famine will not recur.

V. What are reasonable estimates for the condition of Ethiopian agriculture under the following conditions?

- **Continuation of the current situation of civil war and the current set of government policies?**

A steady worsening of food deficits and distribution problems, resulting in a disaster of proportions unparalleled in modern history.

- **Resolution of the civil war but continuation of current policies?**

No improvement in agricultural production--in fact, over the medium term a further tendency toward decline, but greatly improved conditions for international famine relief operations.

- **Resolution of the civil war and agricultural policy reform?**

The more rapid and complete the reforms and the more favorable the circumstances for implementation of them, the more rapidly Ethiopia will begin to realize its potential to feed itself, grow agricultural produce for export and produce agricultural commodities for use in domestic industry and for export as well. With intelligent policies that:

- provide maximum incentives for farmers to plant, grow, harvest, and sell,
- assure them of security of tenure,
- make seeds, tools and fertilizer easily available so that both quantity and quality of production can be improved, and
- encourage domestic and foreign investment in agriculture, Ethiopia can be transformed from a *basket case* to a *breadbasket*. Its natural resources and the talents of its people can enable it to become a major supplier of agricultural produce and processed agricultural products to other parts of the Third World and, selectively, to Europe as well.

VI. Does the fact that Ethiopia has agreed to some liberalization of its agricultural price and marketing policies in order to qualify for World Bank loans enhance the prospects for the United States to provide agricultural development assistance?

The basic changes which Mengistu proclaimed in early March 1990 would appear to meet most of the policy objections that the United States has raised to World Bank loans for agricultural projects in Ethiopia. The test should not, however, be the letter of the reforms but their *implementation*. If Mengistu's regime continues to deteriorate at the accelerated rate we have observed during recent months, we will soon be dealing with a post-Mengistu regime which will be ready to jettison all the unproductive and restrictive agricultural policies that have prevailed to date.

The reluctance of the Marxist-Leninist government to enact reforms has not, however, been the only obstacle to American development aid for Ethiopia. Problems remaining from nationalization of American property and from arrears in Ethiopian government debts to the United States will also need to be resolved. These restrictions result from laws passed by the Congress. With good will on the Ethiopian side--often absent until recently--these problems could be settled quickly.

With genuine reform, Ethiopia will become attractive for many kinds of outside assistance, for it has continued to draw substantial economic aid from several European countries and the EEC even under the adverse conditions of the past ten years. Since Ethiopia will have to compete with the rest of the world--including, now, Eastern Europe and perhaps parts of the disintegrating Soviet Union--for grant aid and loan funds that can be made available by governments and international organizations, post-Mengistu Ethiopian officials should be encouraged to think more and more in terms of attracting American, European, Japanese and Middle Eastern *private investment*. A number of factors can make Ethiopia more attractive to private investors than many competing countries.

For example, even under the strain of misguided policies and civil war, Ethiopia has maintained a sound financial system and has not suffered serious inflation. If this advantage can be preserved during a transition period, investors will find it much easier to calculate risks and gains. The country possesses experienced officials who can administer an investment incentive program effectively. Large numbers of educated and skilled Ethiopians have gained experience abroad during the past 15 years and many (especially Eritreans) have accumulated capital of their own. If some return (as many say they wish to) and bring their skills and their capital with them, they will give the country advantages many Third World countries lack.

Finally, Ethiopia has research institutions and several state enterprises which have preserved their managerial autonomy under Marxism and operate according to sound international standards. These can provide services needed for economic rejuvenation and expansion. Some

of these organizations may be attractive to investors in their own right.

The worldwide pace of agricultural and technological innovation is likely to *accelerate* during coming decades. Ethiopia has an encouraging potential too participate in this process, but time has been lost that needs to be made good. Ethiopia is already lagging badly in application of Green Revolution techniques. Promising new crops--such as the unique oilseed, *Vernonia galamensis*, discovered in Ethiopia by a U.S. Department of Agriculture biologist, have gone unexploited because of governmental prejudice, disorganization and the fact that the crop can best be grown and processed by individual farmers. Ethiopia is one of the world's few major centers of biodiversity which has barely begun to be explored. If extensive investigation of, and experimentation with, both plants and animals are encouraged, new cultivars for food and industrial use and more productive techniques for exploiting livestock and wildlife are likely to be discovered. The country's hydropower resources have barely begun to be tapped. If a federal system of government can be devised to encourage regional responsibility and stimulate local initiative, many new horizons can be opened up.

There is no reason to believe that in spite of all the damage it has done, Marxism-Leninism needs to be fatal for Ethiopia. With rational and humane government, intelligent economic and social policies, and unrestricted participation in the commercial and intellectual life of the Free World, Ethiopia's prospects for rapid recovery are excellent.

Washington, D.C.
15 March 1990

Attachment

The Example of Kenya

KENYA'S experience with drought and famine in 1984-85 contrasts so sharply with what happened in Ethiopia that few people realise that Kenya had a problem at all.

Actually the effects of drought were far more severe in Kenya than in Ethiopia (where only parts of the country were affected). The food deficit was almost exactly the same for both countries: about 900,000 tons. Since Kenya has only half the population of Ethiopia, the threat was, in effect, twice as great. Although Kenya has only half Ethiopia's area, the two countries are geographically similar. They consist of temperate highlands surrounded by desert lowlands. Kenya has fewer natural advantages than Ethiopia. Its highlands are more densely cultivated and settled than most of Ethiopia. Kenya's problem should have been worse. Still, no one starved in Kenya. Few people were uprooted, none for long. There were no refugee camps populated by walking skeletons. Since there was nothing dramatic for TV cameras to focus on, Kenya's situation received almost no international media attention.

How, then, was the food problem solved? Did Kenya's leaders work some magic?

THE MAGIC OF KENYA was merely good sense—a commodity rare enough in most of Africa to be regarded as extraordinary.

Officials high and low in Kenya recognised the problem in good time. They were frank about consulting with foreign advisers and donors. An intelligent government planning process was set in motion, coordinated by the Office of the President. An inter-ministerial "drought response committee" was set up before the population felt the effects of food shortage. This committee began ordering food imports through normal commercial channels, and at the same time started negotiations with donors, took account of shipping and port capacities, and assessed the distribution problem. It was decided early in the process that in so far as possible normal commercial distribution channels would be used to get food to the areas that were going to experience the most acute shortages.

There was no secrecy, no cover-up, no pretending that the problem didn't exist. There was no sense of panic. The people could feel fairly confident that the government had their interests at heart.

ETHIOPIA'S MARXIST RULERS *talk of the wonders of socialist planning—but all the initial "planning" they did in connection with the developing famine was to try to pretend that it did not exist.*

They discouraged foreign governments, private relief agencies and journalists from reporting on it and interfered with early famine relief operations. They never reconciled themselves to donors' efforts to see that food reached starving people in areas outside of the Derg's control. There were no such problems in Kenya, of course, because the Kenyan government has not been trying to goad its peasants into collective farms or to subdue rebels. No one is rebelling in Kenya, for Kenya's government, in spite of some shortcomings, comes closer than most in Africa to being genuinely representative of its people.

FOR KENYA drought and the threat of famine were a serious problem but never became a crisis.

By mid-1985, 850,000 tons of grain had been imported—but more than 60% of it came through normal commercial channels and was paid for by the Kenyan government. Donor grants supplied only 35%. All of this food was distributed through normal sales outlets at normal prices. Thus, problems of black-marketeering and diversion to non-priority uses were largely avoided. Since Kenya did not permit any of its people to reach the point of starvation, and since peasants did not flee from their normal living areas, the vast needs for emergency medical services and supplies of blankets, clothing, and elementary household goods that were (and still are) required in Ethiopia, never arose. And since the framework of rural life was not disrupted, when the rains came again in 1985, farmers could go back to work on their land with no needs other than seeds to sow.

A STUDY OF *the Kenya situation has just appeared—J. M. Cohen and D. B. Lewis, "The Role of Government in Combatting Food Shortages: Lessons from Kenya 1984-85" in M. Glantz (ed.), "Drought and Hunger in Africa" (Cambridge University Press, 1986). It sums up the lessons Kenya demonstrates.*

> "Analysis of the Kenya drought response experience provides more than a rare example of a government's successful effort to prevent famine. It offers insights of potential use in challenging and improving current conventional prescriptions for responding to food shortages, especially in Africa. There has been a tendency to overlook the quietly effective action taken by some governments in averting . . . catastrophes. Successes . . . by virtue of their non-crisis nature do not draw attention, so they . . . go unrecognised and their significance unappreciated."

Unlike Ethiopia's military Marxists, the pragmatic civilians who lead Kenya have not tried to capitalise on drought and famine to impose unwanted policies on their peasants. There is no collectivisation or "villagisation." There are intensified efforts to provide better seeds and more fertiliser, to encourage double-cropping, to extend irrigation so that marginal lands can be cultivated. All this is being done not in the framework of a coercive Marxian-socialist system, but with emphasis on private property and individual initiative. When Kenyans form cooperatives, they do it voluntarily and on their own terms.

IS THERE a lesson here for Ethiopia? Of course there is, but there is no hope under current circumstances that the military Marxists who have that country in their grip will apply it. Their priority is political power, not productivity.

P.H.

ENCOUNTER
JULY/AUGUST 1986

RESPONSES OF RAYMOND W. COPSON TO WRITTEN QUESTIONS

Congressional Research Service
The Library of Congress

Washington, D.C. 20540

March 16, 1990

TO : Honorable Albert Gore, Jr.
Attention: Frankie King

FROM : Raymond W. Copson
Specialist in International Relations
Foreign Affairs and National Defense Division

SUBJECT : Response to additional questions on sustainable agriculture in Ethiopia.

This memorandum has been prepared in response to the six questions you submitted on February 27. These questions were a follow-up to my testimony at the Joint Economic Committee's February 23 hearing on Agricultural Development in Ethiopia.

1. **What are the major environmental problems in Ethiopia and how are they being addressed? Are some areas in Ethiopia so far beyond the local environment's ability to support the population that outmigration is necessary?**

A basic environmental problem with respect to food security is the low rainfall and recurrent drought in populated regions of northern and northeastern Ethiopia. A second major difficulty is the degradation of farmland in the central highlands, which have traditionally produced the bulk of Ethiopia's food.

Much of the northeastern quadrant of Ethiopia lies in marginal agricultural zones averaging a maximum of 28 inches of rain each year along the southern fringe and dropping to a maximum of 8 inches annually toward the coast. Most of Eritrea is classified as arid by geographers, while nearly 70% of Tigray is arid or semi-arid. All of this area, inevitably, is subject to frequent drought. An estimated 98% of Eritrea's rural population and 53%

of Tigray's live on these marginal lands,[1] as do significant numbers in Wollo. The total population of the three provinces may exceed 8 million.

The central highlands, by contrast, generally receive adequate or even plentiful rainfall, and could in theory produce a significant agricultural surplus in most years. Indeed, some years ago, economic analysts wrote of a future in which Ethiopia would export food to the Middle East.[2] However, geography, climate, and poor farming practices have combined to exhaust farmlands in Shoa province, where the capital is located, and in the adjacent fertile portions of Wollo. The high plateaus of this area are cut by ravines, subject to torrential downpours, and almost entirely deforested. Overgrazing and primitive plowing methods have added to these problems to create large-scale erosion.

The central highlands gradually give way toward the west and southwest to highlands at lower elevations, savannah, and finally tropical lowlands. Since much of this area is fertile, well-watered, and thinly populated, there has been an ongoing interest among Ethiopian authorities and donor agencies in resettling impoverished northern farmers there. The U.S. Agency for International Development proposed funding a modest resettlement effort in Fiscal 1975,[3] but the proposal was shelved with the Ethiopian revolution. The World Bank was also pursuing a resettlement project in the central western lowlands at that time.[4] The donor agencies would never have considered any program comparable to the massive forced resettlement program undertaken at immense human cost by the Mengistu regime in 1984.

Whether large-scale outmigration to resettlement areas could ever offer a solution to the problems of the north, where population exceeds the carrying capacity of the land under the current system of production, is questionable. Limited and carefully-planned resettlement, accompanied by extension services for the newly-transported farmers, could contribute to an overall increase in

---

[1] Gamachu, Daniel. Peripheral Ethiopia: A Look at the Marginal Zones of the Country. In Peter Treuner, Tadesse K. Mariam, and Teshome Mulat (eds.), Regional Planning and Development in Ethiopia. Institute of Development Research, Addis Ababa University and Institute für Raumordnung und Entwicklungsplanung, Stuttgart University, 1985. p. 81-91.

[2] Melady, Thomas P. The Economic Future of Ethiopia. Pittsburgh, Duquesne University, 1959. p. 19. The same point was often made of neighboring Sudan.

[3] U.S. Agency for International Development. Fiscal Year 1975 Submission to the Congress. Africa Programs. p. 29.

[4] Ibid. The World Bank gave no support to the revolutionary government's massive resettlement schemes. U.S. Library of Congress. Congressional Research Service. World Bank Activities in Ethiopia, by Jonathan E. Sanford. Washington, 1987. CRS Report 87-857 F.

Ethiopia's agricultural output. However, in view of Ethiopia's high population growth rate, it would be necessary to move a large number of northern farm families in a short time period if the northern population were to be reduced. Such a sudden, large scale population movement might only transfer overcrowding and poor farming practices into new areas.

Significant outmigration from the north to Ethiopia's cities and elsewhere is no doubt inevitable, in view of the north's many problems, but this migration will probably not reduce the overall population of the region. War and the associated problem of famine could do so, and we are now confronted with this grim prospect. When peace is restored, however, it is likely that the population will rapidly recover from any setback through natural increase and the return of refugees. Consequently, development planners will probably look to means other than outmigration for sustaining the northern population. These means will include reforestation, terracing, and other measures to reduce erosion and restore productivity in Shoa and Wollo. Dry lands agriculture and livestock improvement projects will probably also be attempted in Eritrea and Tigray. Transportation improvements, meanwhile, could help to assure that food from other parts of Ethiopia could be delivered into the north in times of drought.

2. **Is it reasonable to talk about agricultural progress in Ethiopia until the current series of wars has ended? To what extent has food been a weapon in the civil war?**

While it is possible to carry out agricultural development projects in secure areas in Ethiopia, it is doubtful that significant overall progress can take place while the wars continue. The fighting imposes numerous strains on the Ethiopian government that interfere with agricultural progress. These include the diversion of perhaps half the national budget or more to the war effort, the manpower drain, and the distraction of policy makers. Moreover, national transportation and market networks have been disrupted, and one of Ethiopia's two ports has been lost. The government restricts the travel of foreign experts outside the capital, hampering donor efforts in agricultural development. Recently, some guerrilla forces have been reported as close as 80 miles to Addis Ababa. Should they move closer, or launch a terror campaign there, foreign experts and donor representatives could be deterred from visiting Ethiopia, endangering the flow of foreign aid and advice. Ethiopian government officials would undoubtedly be less attentive to agriculture needs in such a situation.

At the present time, however, war would not pose a direct obstacle, in terms physical security, to agricultural projects and project participants in productive regions in central and southern Ethiopia. Guerrilla bands do operate in western, and have disrupted development efforts in this area. Illubabor province, in the southwest, has considerable resettlement potential, but is unstable, partly because of the presence of guerrillas from southern Sudan.

Perhaps the best that might be hoped for in wartime Ethiopia is that individual development projects in secure areas would benefit the participants, enabling them to feed themselves, while increasing food supplies in the immediate area. Projects that succeed in these terms might serve as models for boosting output nationwide when Ethiopia's wars come to an end.

Food as a weapon. Food is a scarce resource in Ethiopia and important to both the government and the armed resistance forces in winning power and influence. Journalists have tended to place greater blame on the Ethiopian government, however, rather than the resistance forces, for using food as a weapon. It has been reported that the government has given priority to militia members in the distribution of food aid in the north, distributed inadequate supplies of food to northern civilians under its control, required civilians to pay back taxes before receiving any food relief, and refused to allow relief convoys to cross battle lines into rebel-held areas.[5]

Resistance relief organizations, by contrast, are generally credited with genuine efforts to distribute food relief to civilians in the areas they occupy. Guerrillas in Eritrea attacked a relief convoy in October 1987, destroying several critically-needed trucks, but they subsequently pledged to try to avoid such incidents in the future. It seems unlikely, nonetheless, that the resistance forces are entirely innocent of using food to advance their objectives. No doubt the distribution of food aid to civilians enhances the popularity of the resistance. The February 1990 attack on Massawa by the Eritrean People's Liberation Front (EPLF), meanwhile, will have a momentous impact on the food situation in the north. Relief organizations and donor governments may be forced to deal more closely with the EPLF if they are to get adequate relief supplies to the hungry. Before the attack, it had been expected that most food relief would be brought in through the government-held port and then taken into rebel-held areas -- if the government agreed -- by private and voluntary organizations. Now it appears that most relief will have to be delivered directly to guerrilla-held areas. The famine in the north will probably also lead to an increase in international pressure on the Mengistu regime to conclude a negotiated settlement with the resistance.

---

[5] See, for example, Jane Perlez, As the Fears of Famine Grow in Ethiopia, War Imperils Relief. New York Times, February 15, 1990; and Colin Campbell, Ethiopia Using Food as Tactic in Rebel War, copyright 1988, Atlanta Journal and Atlanta Constitution, reprinted in U.S. Congress. House. Ethiopia and Sudan: Warfare, Politics, and Famine. Hearing, Select Committee on Hunger, 100th Congress, second session, July 14, 1988. Washington, U.S. Government Printing Office, 1988. Serial No. 100-30. p. 123-127.

3. **Has food aid been supplied in an effective manner? Has the use of feeding stations, rather than moving food to villages resulted in more dislocation to local economies and migration than was necessary?**

Food aid has been credited with saving millions of lives in Ethiopia,[6] and there is little reason to doubt this assessment in view of the vast amount of aid that has been donated. Food relief specialists would prefer that all such assistance could be provided in ways that would not disrupt village life. In the 1987-1988 famine, for example, when food supplies had been pre-positioned in Ethiopia, family heads were encouraged to come to storage centers at regular intervals and carry sacks of food back to their villages. Thus they did not need to relocate their entire families to a feeding camp for the duration of the famine. In addition, food aid experts urge that in so far as possible relief be used to strengthen the capacity of a community to feed itself in the future. Food for work projects, which compensate participants with food for erosion control or other conservation and reclamation efforts, have been used with some effect in Ethiopia.

During the 1984-1985 famine, however, it was not always possible to use food aid in the most effective ways, particularly in the north where the famine was most serious. Many hungry people were on the move even before food relief had arrived, and there was little alternative to bringing these people into feeding sites for the most rapid distribution of relief. Poor sanitation and contagious disease were serious problems at these camps.

In the current crisis, donors are urging a ceasefire that will allow large quantities of food aid to be taken by truck into northern Ethiopia and distributed in or near villages. If there is no ceasefire, however, and Massawa port remains closed, it will not be possible to transport food to local distribution points. Meanwhile, whatever aid may reach rebel-held territory overland by clandestine means will not be adequate for feeding the potential millions who could be affected by food shortages. Consequently, it may be that feeding centers will again be needed, possibly near airfields where food flown in from Djibouti or elsewhere. Ethiopian government planes, however, control the air over the afflicted regions, and such a scheme could probably not be put into operation without government concurrence. Consequently, even feeding stations may not be a viable option for delivering food in the current crisis. In neighboring Sudan, however, feeding stations are likely to be set up for the thousands of Ethiopian refugees reportedly fleeing across the border.

---

[6] See, for example, U.S. Congress. Senate. Committee on the Judiciary, Subcommittee on Immigration and Refugee Policy. Ethiopia and Sudan One Year Later: Refugee and Famine Recovery Needs. A Minority Staff Report. 99th Congress, 2d session, May 1986. S. Prt. 99-168. Washington, U.S. Government Printing Office, 1986. p. 1.

4. **Comparisons have been made of Kenya and Ethiopia in terms of the effects of the 1984-1985 drought. Kenya experienced a comparable drought but had less disruption of food supplies than Ethiopia and no famine. Are these comparisons fair? What accounts for the better conditions in Kenya? What changes would Ethiopia have to make to replicate the Kenyan experience?**

The drought was somewhat less serious in Kenya, where a portion of the country was not fully affected and where good rains returned before the end of 1984. Nonetheless, Kenya also escaped disaster because it had better policies and a better policy-making process than Ethiopia. Kenyan planners had anticipated food shortages in 1984 and issued food aid requests in a timely manner. In addition, the Kenyan government had foreign exchange reserves on hand which enabled it to purchase food on the open market. Once food was in the country, it was distributed through commercial channels and food for work programs, minimizing disruptions to society and the economy. Kenya has a well-developed transportation network in most areas and was free of war, so that distribution was not a problem. Nonetheless, there were reports of some food shortages and heavy livestock losses among pastoral peoples of the northeast.[7]

Despite Kenya's relative strengths, observers are concerned about possible long term dangers to food security there. They point to Kenya's burgeoning population, which could double in less than 20 years; to deforestation and soil loss; and to a decline in agricultural yields as marginal lands are brought into production.[8] Kenyan policy-makers and aid donors will be hard pressed to resolve these problems before the next decade is far advanced.

5. **What are reasonable estimates for the condition of Ethiopian agriculture under the following conditions?**

Continuation of the current situation of civil war and the current set of government policies.

Ethiopia's current policies are uncertain following President Mengistu's announcement of major economic and social reforms on March 5, 1990. These reforms are supposed to include a reduction in central planning, a freer private sector, and the potential for private farms. Peasants would be allowed to leave collectives, sell their own crops, and bequeath their land -- although

---

[7] Financial Times of London, December 14, 1985. Reprinted in Africa Research Bulletin, Economic, Financial, and Technical Series. December 31, 1985. p. 7520-7521.

[8] Ford, Richard B. and Janet Welsh Brown. Land, Resources, and People in Kenya. In Janet Welsh Brown, ed., In the U.S. Interest: Resources, Growth, and Security in the Developing World., World Resources Institute, Westview Press, 1990. p. 121-163.

the government would retain title. These reforms, if implemented, would no doubt boost agricultural output in secure areas, although Ethiopian farmers, as will be noted below, are probably handicapped by historical experience in their ability to respond quickly to market forces. In any event, the depth of Mengistu's commitment to reform has yet to be tested, and it is possible that his announcement represents a desperate and temporary response to a deteriorating military situation.

Agriculture, moreover, can only make limited gains while the war continues. Foreign trade, domestic transport, and government spending have all been severely disrupted by Ethiopia's wars. Until the fighting ends, Ethiopia will not make substantial economic progress in any sector.

Resolution of the civil war but continuation of current policies.

Most observers agree that Ethiopia's focus on state farms and collectives would limit agricultural growth, even if peace should come. If that focus is now changing, as seems possible, peace would bear a significant dividend. Even without reform, however, resolution of the war would no doubt improve Ethiopia's agricultural situation somewhat, since it would restore security in rural areas nationwide, allow the normal importation of agricultural inputs, facilitate exports, and free government resources. Some donors, moreover, would probably be moved by the end of the war to offer rehabilitation assistance that would benefit the agriculture sector in part.

Resolution of the civil war and agricultural policy reform.

This of course would be the ideal situation, helping Ethiopia to realize its rich agricultural potential. Major progress, however, could require many years, in view of the heavy burdens Ethiopia's history has imposed on agriculture. Ethiopia has no experience with an independent yeomanry or an innovative landowning class. Before the revolution, landlords and peasants had little or no incentive to boost output because of a variety of traditional restraints, including the lack of a concept of private ownership of land and the constant danger that crops would be confiscated.[9] This system contributed to the degradation of Ethiopian farmland and a general lack of knowledge of modern farming practices in the rural areas.

The revolutionary government undertook a massive rural literacy campaign and launched extension programs, but never managed to jolt the rural areas into higher productivity. Indeed, peasant caution over innovations contributed to a drop in output after the revolution. In addition, the focus on collectives and state farms, as well as market controls, failed to give farmers needed incentives.

---

[9] Donham, Donald. Old Abyssinia and the New Ethiopian Empire: Themes in Social History. In Donald Donham and Wendy James (eds.), The Southern Marches of Imperial Ethiopia: Essays in History and Social Anthropology. Cambridge, Cambridge University Press, 1986. p. 14-17.

As a result of this historical experience, both before and after the revolution, the extent of agricultural change required in Ethiopia is quite substantial. If major progress is to be made, policy reform would probably be only part of a program that would require changes in land tenure patterns as well as programs in rural education, land reclamation, agricultural research, and rural infrastructure.

The pre-revolutionary government of Ethiopia, while largely failing to deal with fundamental problems in the traditional agricultural system, was working to strengthen medium and large scale commercial farms at the time of its overthrow. The development of the vast and potentially productive Awash River basin under the Awash Valley Authority (AVA) attracted particular attention from donors.[10] The irrigation and new settlement connected with this scheme gave rise to environmental concerns, however, and the farms established along the river cut the area's nomads off from a traditional source of water. Nonetheless, the potential for increased production in this and other valleys is significant and it may be that commercial farms in these areas will make a contribution to Ethiopia's food supply in the future.

6. **Does the fact that Ethiopia has agreed to some liberalization of its agricultural price and marketing policies in order to qualify for World Bank loans enhance the prospects for the United States to provide agricultural development assistance?**

The World Bank has found Ethiopia's agricultural reforms sufficient to end its suspension of a large International Development Association (IDA) loan for a Peasant Agricultural Development project. Lending for this and other agricultural projects is the largest component of the World Bank program in Ethiopia. The United States works closely with the Bank in supporting agricultural development around the world, and the Bank's favorable evaluation of the Ethiopian agricultural reforms could have some influence on the thinking of U.S. policy makers in the foreign assistance field.

U.S. officials would be far more impressed, however, if the limited World Bank program in Ethiopia were expanded to include large scale lending in support of structural change in the Ethiopian economy. This would mean that the regime had satisfied the Bank's economists with a plan for a major re-orientation designed -- among other objectives -- to strengthen private farmers and reduce government controls over agriculture. In the absence of a Bank-approved structural adjustment program, U.S. officials may continue to feel that Ethiopia's reforms have not gone far enough. At the present time, the Bank itself still has reservations about many aspects of Ethiopia's economic policies, including policies that affect agriculture.

---

[10] Mulat, Teshome. The Awash Valley Authority: A Case in Regional Development. In Peter Treuner, Tadesse K. Mariam, and Teshome Mulat (eds.), Regional Planning and Development in Ethiopia. p. 226-237.

PANEL II. ROLE OF NONGOVERNMENT ASSOCIATIONS IN AGRICULTURAL DEVELOPMENT

Senator GORE. The hearing will come to order. I want to welcome the members of our second panel to the witness table. Robert Buchanan, Horn of Africa regional coordinator for Oxfam America; Tom Getman, director for government relations with World Vision; René Lacoste, director of the projects department with the Jules and Paul-Émile Léger Foundation, a Canadian NGO. We are delighted the three of you could join us for this hearing. As with the previous panel, your prepared statements will be included in the record in full. And if you could keep your summaries to 10 minutes that would be helpful. Mr. Buchanan, we would like to begin with you. Welcome.

STATEMENT OF ROBERT BUCHANAN, REGIONAL COORDINATOR FOR HORN OF AFRICA, OXFAM AMERICA

Mr. BUCHANAN. It is a pleasure to be here. I will summarize my prepared statement.

Oxfam America is a private nonprofit international agency that funds self-help development projects around the world. We specialize in providing long-term development assistance, but we also do emergency relief. Our funding comes entirely from private sources. Oxfam neither solicits nor accepts any government funds.

Because of Ethiopia's chronic food deficit, Oxfam's program in Ethiopia has focused primarily on increasing food production and household income among subsistence farmers who comprise most of the country's population.

Oxfam is a funding agency and our preference is to fund projects through indigenous organizations working at the grassroots level in rural areas. In Ethiopia, this means individual peasant cooperatives, service cooperatives, and peasant associations. They have proven effective at mobilizing communities in support of project activities, managing oxen distribution schemes, and community seed projects, and introducing technical innovations. Peasant associations and cooperatives have been enthusiastic development partners for Oxfam America. They bring their diligence, resourcefulness, and often creative solutions based on their own experience to very difficult development tasks.

Oxfam America prefers not to work directly with governments, but in a tightly controlled political environment such as Ethiopia's, government contact is unavoidable. The Government requires all NGO's to register and formal project agreements are required between each NGO and the appropriate government ministry. The Government also controls access to project sites through visas and internal travel permits.

Oxfam's closest contacts have been with Ethiopia's Relief and Rehabilitation Commission and with the Ministry of Agriculture. Our relationships with both have been positive. There is a high level of expertise and commitment to solving Ethiopia's agricultural and environmental problems evidenced through these contacts. Oxfam's experience is that we are able to present our own development proposals and, after some discussion and clarification, to win government support for them.

The primary constraints to effective long-term development work in Ethiopia are, one, war and, two, government policies that create a cycle of inescapable household debt for the poor.

War disrupts normal agricultural activity as some of the previous witnesses have pointed out. It prevents planting and harvesting during critical periods and it displaces hundreds of thousands of rural people. Also, with an estimated two-thirds of Ethiopia's national budget going to the war effort, little is left over for agricultural or other development activities.

Economic policies designed to keep food prices low for urban consumers exacerbate debt for rural small producers. Ethiopia's state-run agricultural marketing system requires farmers to meet production quotas for grains for which it pays typically from one-quarter to one-half the market price. High taxes add to the peasant farmer's economic burden. Ethiopia's small farmers, who are the backbone of the agricultural sector, are financially squeezed and unable to accrue either cash or food surpluses as they are driven ever more deeply into household debt. As a result, individual resources that might otherwise sustain them in drought years or be reinvested to improve farm production are paid instead to the Government principally to finance the war effort.

Despite these constraints, long-term development is feasible in Ethiopia. Oxfam's approach has been to provide three types of aid: One, direct inputs to farmers—oxen, seed, tools in drought-prone areas, two, research and promotion of peasant-based technologies that show promise of increasing food production on a wide scale, and, three, training in improved farming techniques, small income-generating activities and environmental rehabilitation.

In Eritrea, Oxfam recently completed a 3-year agricultural rehabilitation project that provided seed and oxen to 600 poor farmers. The oxen were supplied in stages as land terracing progressed in this mountainous area which is suffering from deforestation and soil erosion. As a result, farmers have been able to plow and plant their lands at the optimum time of year, increasing staple crops like wheat and barley. The project is now self-sustaining and the goal of food self-sufficiency is within sight for the project area.

In the Hararghe region of eastern Ethiopia, Oxfam has provided assistance to a group of seven service and producer's cooperatives in the form of irrigation pumps, canals, vegetable seed and fruit trees, dairy equipment, grinding mills, nurseries for reforestation programs and oxen purchase on a revolving loan basis. By increasing staple food production, generating cash income from fruit, vegetable and dairy production, as well as planting tree seedlings on deforested hillsides, the project farmers are making gradual progress toward food self-sufficiency, improved health and nutrition, and restoration of the environment.

Oxfam has played a unique role by linking research institutions directly with the needs, priorities, and experiences of poor farmers. Since 1986, Oxfam has funded demonstration and development of a new ox-drawn broadbemaker plow to improve yields on heavy black clay soils called vertisols. In on-farm trials, the wheat yield increased by 240 percent. Oxfam is working to integrate this low-cost, high-potential technology into the Ministry of Agriculture's extension program. Unfortunately, fighting in the project area in

Wollo interrupted this project in the fall of 1989 and further work has been suspended for the time being.

Other technologies Oxfam has supported include: the single ox plow, ox-drawn scoops for pond construction, the donkey plow and harness, and introduction of the arbil, a simple land-leveling and ridge-making tool from Sudan.

In the Gonder region Oxfam has funded training in the production of mud stoves to increase income and promote the spread of this environmentally beneficial technology. The stoves consume only about half the firewood of traditional cooking fires, thereby easing pressure on Ethiopia's already decimated forest resources. Interest in the mud stove technology is strong; expansion of the current program is planned.

In addition, Oxfam has supported an agricultural research and training program. More than 2,000 men and women have been trained in basic and advanced phases of agricultural extension. Laboratories for soil analysis, plant production and veterinary diseases have been established and equipped.

Oxfam is convinced that there is real potential for sustainable development in Ethiopia's agricultural sector. Not only is such development feasible, it is essential if the cycle of drought, famine and emergency aid is to be broken. The obstacles are formidable but Ethiopia's potential remains high. Abundant fertile land with untapped agricultural potential, a hardworking and resourceful citizenry committed to solving their problems, and a wealth of in-country experience and expertise present opportunities for genuine progress.

However, who receives assistance and how that aid is provided are crucial issues. Large-scale development projects funded directly through government agencies tend to provide few benefits, if any, to poor subsistence farmers and can actually be harmful to their interests. Large-scale development assistance to the Government of Ethiopia, however well-intentioned, could be used in ways that reflect its centralized approach to administration. We would be concerned that such assistance could be used to support Ethiopia's rural development agenda which has in the past included such controversial items as heavy subsidies for uneconomic state farms, forced resettlement programs and mandatory villagization. Oxfam America does not lend support to these policies and programs through our project activities.

Sustainable agricultural change cannot be imposed. It must come about with voluntary participation at the grassroots level based on commonsense approaches. Poor farmers must be involved in developing plans and projects that reflect their own experience, needs, priorities and available resources. Oxfam has focused our development work in Ethiopia on small, practical interventions with local farmer organizations. We believe this approach has yielded solid and sustainable gains.

The case for long-term development as the only alternative to continuous famine relief is compelling. At the same time, Oxfam America believes that any long-term aid which the U.S. Government may consider offering to Ethiopia should be linked to clear progress on key issues such as resolving the armed conflicts, improving human rights conditions, and liberalizing economic policies

that undercut self-reliance and perpetuate Ethiopia's grinding poverty. The U.S. Government should take advantage of Ethiopia's interest in Western aid and improved ties to press for changes that, together with grassroots agricultural development, offer the only hope of ending Ethiopia's structural food deficit and recurrent famines.

Thank you.

Senator GORE. Very good. Thank you for that statement and we will hold the questions until the other panelists have completed theirs.

[The prepared statement of Mr. Buchanan follows:]

PREPARED STATEMENT OF ROBERT BUCHANAN

Long-Term Development Aid to Ethiopia: Oxfam America's Experience

Oxfam America is a private nonprofit international agency that funds self-help development projects in more than thirty countries in Africa, Asia, Latin America and the Caribbean. While Oxfam specializes in providing long-term development assistance to grassroots groups, emergency aid is provided when needed. Oxfam's funding comes entirely from private sources including individual donations as well as some corporate and foundation support. Oxfam neither solicits nor accepts any government funds.

Oxfam America has funded development projects and relief programs in Ethiopia since 1978. Because of Ethiopia's chronic food deficit, Oxfam's program has focused primarily on increasing food production and household income among subsistence farmers who comprise most of the country's population.

Oxfam America's approach has been to provide basic agricultural inputs on a small scale to selected high-potential farmer organizations and to develop with farmers appropriate peasant-based technologies aimed at increasing food production. The size of Oxfam's development grants in Ethiopia ranges from $400 to over $100,000 although the average is around $50,000.

Oxfam America is a funding agency; that is, we are not operational and do not implement projects with our own staff. Although Oxfam America has an office in Addis Ababa with a small staff, projects funded by Oxfam America are implemented by project partners in Ethiopia, mostly non-governmental organizations (NGO's) with their own operational programs and staff.

Our preference is to fund projects through indigenous organizations working at the grassroots level in rural areas. In Ethiopia, this has meant that Oxfam's primary project partners have been individual peasant cooperatives, service cooperatives and peasant associations. These are legal entities organized by the Government of Ethiopia. They are virtually the only channels through which NGO's can work in rural areas. Oxfam's experience has been that the leadership and management of cooperatives and peasant associations varies greatly. They have proven effective at mobilizing communities in support of project activities, managing oxen distribution schemes, and community seed projects, and introducing technical innovations. However, they appear to be less well-equipped to manage administrative and accounting matters, project design and planning, or activities requiring a high degree of logistical management or purchasing. These latter functions are usually performed by staff of intermediary NGO's. Nevertheless, peasant associations and farmer cooperatives have proven to be enthusiastic development partners who bring their diligence, resourcefulness, and often creative solutions based on experience to difficult development tasks. Oxfam America's work in Ethiopia has been immeasurably enriched by their participation and support.

Oxfam America staff have regular direct contact with the farmer organizations receiving assistance to identify specific project activities as well as to monitor and evaluate progress toward meeting agreed-upon project objectives. For administrative purposes it has been necessary for Oxfam to provide its assistance to these farmer organizations through an intermediary operational agency such as our sister organization OXFAM UK and Ireland, the Ethiopia Freedom from Hunger Campaign, the International Livestock Center for Africa, or the American Joint Distribution Committee.

As a general rule throughout the world, Oxfam America prefers not to work directly with governments, gearing our funding instead toward direct aid to grassroots development efforts through non-governmental organizations. In a tightly-controlled political environment such as Ethiopia's, however, it is not possible for Oxfam or any other development agency to work in that country without a certain degree of government contact. All aid agencies, for instance, must be accepted for registration by the government. Furthermore, aid agencies wishing to work on development projects must conclude a formal agreement with the appropriate government ministry before a project can be implemented. This process allows for a dialogue between NGO's and the relevant government ministry which can be beneficial to all concerned. The government receives a clear understanding of the NGO's project goals and methods while technical or logistical support is sometimes forthcoming from the ministry to assist with the project's implementation. In addition, access to project areas is strictly controlled by the government. Visas to enter Ethiopia are required as are internal travel permits for expatriates who travel outside Addis Ababa.

Oxfam's closest contacts have been with Ethiopia's Relief and Rehabilitation Commission (RRC) and the Ministry of Agriculture (MOA). In both cases our relationships have been positive and we have been impressed with the high level of expertise and commitment to solving Ethiopia's agricultural and environmental problems which is evident through these contacts. Government officials have shown a cooperative and supportive attitude toward our project proposals. It is often the case that officials from the RRC and MOA, because they lack government resources to carry out development programs, are enthusiastic about working with organizations like Oxfam which provide the resources for interesting and innovative development work. The government, to be sure, has its own development priorities and projects which it would like NGO's to support, but there has been no heavy-handed pressure to force Oxfam to support them. Oxfam's experience is that we are able to present our own development proposals and, after some discussion and clarification, to win government support for them.

With the exception of a contribution to Ethiopia's famine early warning system made directly to the Relief and Rehabilitation Commission, Oxfam has channeled its funding in Ethiopia to intermediary non-governmental organizations or, through them, directly to local peasant organizations. Oxfam has found that it is possible, through personal contacts with development allies in the RRC and MOA, together with project designs that emphasize farmer control over project resources, to create space in which to carry out innovative projects.

The primary constraints to effective long-term development work in Ethiopia are (1) the continuing and expanding civil conflicts and (2) government policies that create a cycle of inescapable household debt for the poor.

War is certainly the most dramatic obstacle to the development of Ethiopia's agricultural potential. War impedes development in several ways. It disrupts normal agricultural activity, preventing planting and harvesting during critical periods and displaces hundreds of thousands of rural people. Long-term agricultural development requires, at a minimum, that food-growing populations remain relatively stable and that their security is not under threat. Moreover, while the local population is the key to Oxfam America's development projects, some access by outside technical experts and donors (for monitoring purposes) is essential. In a war zone, such a presence becomes too risky.

A good example is provided by one of Oxfam America's most successful projects involving on-farm demonstration of a new plow being conducted in southern Wollo region. In the fall of 1989, fighting between forces opposing the central government and Ethiopian army spilled into this region from the north. As a consequence, work on disseminating the new use of the plow had to be suspended. Oxfam's on-site project consultant was forced to seek safety in Addis Ababa and there is no indication at this point when he might be able

to return to resume the project work. If he is unable to go back soon, the opportunity to demonstrate the plow during the main 1990 growing season will be lost. We are afraid that, even if he can return, the project office and equipment may have been destroyed.

War in Ethiopia hinders development in another way. With so much of the country's national resources going to the war effort--estimated to exceed 65% of the budget, little is left for agricultural or other development activities.

Another constraint on agricultural development in Ethiopia arises from economic policies of the Ethiopian Government which tend to trap the rural poor in a deepening spiral of household debt and thereby perpetuate the country's underlying poverty. With per capita national income in Ethiopia barely $110, poverty is clearly a pervasive factor contributing to Ethiopia's food shortages, environmental deterioration and other problems.

Unfortunately, some of the government's economic and agricultural policies, which are designed to keep food prices low for urban populations and stress collective over individual production, actually exacerbate the problem of household debt for the vast majority of Ethiopia's rural small-holder population. For instance, Ethiopia's state-run agricultural marketing system requires farmers to meet production quotas for grains for which it pays them a low price, typically from one-quarter to one-half the market price. High taxes, including special drought and war taxes, add to the peasant farmer's economic burden. In fact, payment of taxes and meeting individual grain quotas are the subsistence farmers' highest priorities. The farmer will sell his food, seed and livestock in order to raise the needed funds. Oxfam is aware of instances where farmers have been forced to purchase grain on the market to sell to the government at a lower price simply to meet a grain quota. Not surprisingly, with rising taxes and reduced harvests due to periodic droughts, Ethiopia's peasant farmers--who are the backbone of the agricultural sector--are financially squeezed and unable to accrue either cash or food surpluses as they are driven ever more deeply into household debt. As a result, individual resources that might otherwise sustain subsistence farmers in drought years or be reinvested to improve farm production or combat environmental degradation are paid instead to the government, principally to finance the war effort. Small farmers, many of whom lost basic farm resources like oxen, seeds and tools during the 1984-85 famine disaster, have little opportunity to accrue surpluses that could provide them with income to reinvest in the agricultural inputs they lack.

Despite these constraints, Oxfam America believes that long-term development is feasible in Ethiopia. Oxfam's approach to development in Ethiopia has been (1) to work with limited groups of farmers to provide essential farm inputs--oxen, seed, tools--in drought-prone areas with untapped agricultural potential, (2) to research, demonstrate and promote viable peasant-based technologies which show promise of increasing food production, and (3) to provide training in improved farming techniques, income-generating activities, as well as environmental protection and rehabilitation.

In Eritrea, Oxfam recently completed a three-year agricultural rehabilitation project that has provided oxen to 600 resource-poor highland farmers in an area heavily impacted by the 1984-85 famine. The oxen were supplied in stages to maximize agricultural activity as the farmers completed terracing of land for cultivation in a mountainous area suffering from deforestation and soil erosion. As a result, the area has become nearly self-sufficient in food production, an explicit project objective that was not met in 1989 only because of the serious drought affecting the region once again. Nevertheless, it is clear the assisted farmers have increased production of staple crops like wheat and barley substantially. Consequently, they are less dependent on relief assistance and more likely to remain on their land for planting in 1990. No further oxen assistance is planned for this region; the project is regarded as self-sustaining at this time and Oxfam plans to undertake a similar oxen/terracing project in a new, as yet undeveloped, area of Eritrea in 1990.

In 1988 600 farmers from the same area were provided with potato seed, a crop which is not indigenous to the area but for which soil and climatic conditions indicated some potential. The potato seed proved an enormous success that year. Yields were high and potatoes were a welcome addition to the local diet. Sales of surplus potatoes yielded virtually unprecedented income averaging $123 per farmer. One farmer earned over $400 from the sale of potatoes, enough money to purchase a second ox. Due to poor rainfall in 1989, the potato crop in the second year fell short of the success in 1988 with farmers harvesting barely enough for family consumption and for future seed. Farmers remain enthusiastic about the potential for growing potatoes, researching themselves the best methods of seed storage. This project is expected to be self-sustaining; Oxfam has no plans to provide any further potato seed.

One of Oxfam's first comprehensive drought recovery projects after the 1984-85 famine involved a group of seven service and producer's cooperatives located in the Hararghe region of eastern Ethiopia. Assistance was provided for irrigation pumps and canals, vegetable and fruit production, dairy equipment, grinding mills, nurseries for reforestation programs, and oxen purchase on a revolving loan fund basis. By increasing staple food production, generating cash income from fruit, vegetable and dairy production, as well as planting tree seedlings on deforested hillsides, the project farmers are making gradual progress toward the objectives of food self-sufficiency, improved health and nutrition, and restoration of the environment.

In one producer's cooperative, where fruit and vegetables are being grown on newly irrigated land, farmers realized per capita income of $100 in one year. Some of the income was used to sustain the irrigation pumps while the rest was used to purchase family necessities like medicine, salt, sugar and cooking oil. Another cooperative constructed a long irrigation canal from a mountain spring which transformed a near desert valley area into a patchwork of irrigated house gardens more than doubling the amount of irrigated land under cultivation by the cooperative. With irrigation, these cooperatives are now less dependent on the increasingly unreliable rains for their harvests.

One component of the assistance Oxfam America provided to the Hararghe coooperatives was food for work involving reforestation activities. This aspect of the project produced mixed results. While the cooperatives accepted the food-for-work premise, Oxfam has observed that the communities lack any real sense of commitment to or investment in the reforestation work. The local food-for-work beneficiaries are therefore not as careful in planting the tree seedlings or as diligent in maintaining the replanted areas as they might otherwise be. They tend to view the reforestation work as belonging to someone else. They simply provide needed labor for which they are paid in food. To succeed, reforestation projects need strong support from local community members based on a clear personal stake in the benefits of such a program.

As the Hararghe cooperatives illustrate, the impact of direct assistance is maximized when different types of aid are provided as part of a comprehensive development project. In other words, when women benefit as well as male farmers, when cash crops are increased along with staple foods, when water for irrigation also contributes to better child health, then the whole community is involved in the development process. For this reason, Oxfam has used the Hararghe experience as a model for funding a subsequent multi-faceted development project.

Late in 1989 Oxfam undertook a three-year project through the United Nation's Food and Agricultural Organization's Ethiopia Freedom From Hunger Campaign to provide multiple forms of assistance to the Zenga Dormale Service Cooperative in Ethiopia's North Omo administrative region in the south. Located in a drought-prone area, the service cooperative's 3,000 members will receive assistance similar to that provided the Hararghe co-ops: oxen, water development, improved seeds, tools, training and inputs for income-generating activities (raising small animals, poultry, honey production, vegetable gardens) and assistance to combat soil erosion and deforestation. The project is too recent to

evaluate; a base-line survey of household income/debt, agricultural productivity, and general health is currently planned.

Because of Oxfam's limited financial resources, we have sometimes chosen to support the development of promising peasant-based technologies that could significantly improve efficiency and yields on a wide scale. Since 1986 Oxfam has played a unique role among development agencies working in Ethiopia by linking agricultural research institutions directly with the needs, priorities, and experiences of poor farmers. The technologies have been carefully selected in consultation with farmers themselves to ensure that they meet the criteria of low cost, adaptability to locally available materials, and capacity for farmer self-management avoiding reliance on expatriate expertise, imported equipment or expensive inputs. Oxfam's partners in funding technology development projects include the Ethiopia-based International Livestock Center for Africa (ILCA), the Ethiopian Ministry of Agriculture, and the American Joint Distribution Committee.

Promising technologies supported by Oxfam have included the single-ox plow (the two-ox plow is traditional in Ethiopia) as a way of maximizing the use of scarce oxen when they were in short supply following the 1984-85 famine. With the International Livestock Center for Africa, Oxfam supported on-farm research to investigate the single-ox plow's potential. Farmer adoption of the new technology has been disappointing, however. Although the research indicated that farmers were interested in using the single-ox plow for seed covering during the final pass over their fields, in fact they still preferred to wait to share oxen with their neighbors in order to use the traditional double-ox plow for major cultivation and land preparation. A single ox is not strong enough to do the deep plowing which the latter require.

Similarly, Oxfam has co-funded with ILCA a research and demonstration project aimed at developing a new ox-drawn broadbed-maker plow (a modification of the traditional plow) to provide better yields on heavy black clay soils called vertisols which cover roughly 12 million hectares of Ethiopian farmland. The "vertisols" project is one of Oxfam's most successful. In three years of on-farm trials from 1986 to 1989 involving hundreds of individual farmers in both good and poor rainfall years, the plow proved to increase yields dramatically. On average, horsebean production tripled and wheat yields increased by 240% over traditional plowing methods. In some cases, yields increased by as much as 900%. The newly designed plow has also proven to be environmentally desirable as its high yields do not strain soil nutrients and the broad beds which the plow makes hinder soil erosion. As a result of farmer feedback on the plow, the initial version was modified to use a lighter wood and made simpler in construction. As might be expected, farmer response has been highly enthusiastic and Oxfam has begun to work with Ethiopia's Ministry of Agriculture to integrate the technology into the ministry's extension program. To confirm the early positive results, research has continued at the project's demonstration site at Were Ilu in Wollo region but, unfortunately, was interrupted in the fall of 1989 as a result of the extension of civil conflict to that area. Consequently, Oxfam has been forced to suspend the on-farm aspects of this project for the time being.

Other high-potential peasant-based technologies whose development Oxfam has funded in Ethiopia include the use of ox-drawn scoops for pond construction, the donkey plow and harness, and demonstration of the "arbil," a simple land-leveling, ridge-making tool from Sudan. The ox-drawn scoops have proved a popular means by which service cooperatives in Hararghe and elsewhere are constructing community ponds as an alternative to more labor-intensive digging with hand tools.

The donkey harness was introduced on a demonstration basis to a small number of farmers in Eritrea. Although the preferred draft animals--oxen--are in short supply, necessitating borrowing and planting at non-optimal times, donkeys are readily available though considered principally as pack animals. The testing has revealed that plowing with donkeys is only feasible in areas of light soils and that farmers view their use only as a last resort. However, Oxfam believes the donkey harness and plow can make a contribution

to food production by providing a readily available and low-cost alternative when the ox-drawn plow is not available.

The arbil was introduced by Oxfam on a demonstration basis to farmers in Eritrea where farmers were engaged in extensive terracing activities to improve yields and prevent soil erosion. On-farm tests revealed that the implement, made from locally available materials at a cost of $22 each, was an efficient alternative to hand leveling, saving farmers 42% of their labor time. Farmer response has been enthusiastic with the result that the arbil has been replicated for wider testing under different ecological conditions.

A current Oxfam America project, funded through the American Joint Distribution Committee working with service cooperatives in Gonder region, is somewhat of a departure from the previous agricultural improvement technologies. In this case Oxfam supports the training of cooperative members in the production of mud stoves to sell to increase off-farm income and to promote this environmentally beneficial technology. Because mud stoves consume only half the firewood of traditional cooking fires, the demonstration and spread of this technology will ease pressure on Ethiopia's already decimated forest resources that contribute to the country's extensive loss of topsoil. Initial results of the project indicate that interest in the mud stove technology is strong; the training is progressing well, and expansion of the training program is currently planned.

In addition to direct farm inputs and appropriate technology development, Oxfam America has funded projects of general support to agricultural activities--for instance, an agricultural research and training program. More than 2,000 men and women have been trained in both basic and advanced phases of agricultural extension, and laboratories for soil analysis, plant protection and veterinary diseases have been established and equipped. In addition, important hydro-meterological data needed for production planning is now being systematically gathered as part of the project's research component.

On the basis of many years of experience funding development projects in Ethiopia, Oxfam America is convinced that there is real potential for sustainable improvement in Ethiopia's agricultural sector. Not only is such development feasible, it is essential if the cycle of drought, famine and emergency aid is ever to be broken. Recurring famine in Ethiopia is only the most dramatic evidence of the enormous needs of Ethiopia's people, the overwhelming majority of whom are poor subsistence farmers. There are viable channels for addressing some of their basic needs through long-term development. The obstacles are formidable--war, ecological decline, and neglect of the smallholder sector of the economy--but Ethiopia's potential remains high. Abundant fertile land with untapped agricultural potential, a hardworking and resourceful citizenry committed to solving their problems, and a wealth of in-country experience and expertise present opportunities for real progress.

However, <u>who</u> receives assistance and <u>how</u> that assistance is provided are crucial issues within the Ethiopian context. It is Oxfam's view generally that large-scale development projects funded directly through government agencies tend to provide few, if any, benefits to poor subsistence farmers and can actually be harmful to their interests. Large-scale development assistance to the present Government of Ethiopia, however well-intentioned, would most likely be used in ways that reflect its centralized approach to administration. Moreover, such assistance could be used to support the current regime's agenda for Ethiopia's rural development which includes or has included in the past such controversial items as heavy subsidies for uneconomic state farms, forced resettlement programs, and mandatory villagization. Oxfam America is careful not to lend support to these policies and programs through our project activities.

Sustainable agricultural change cannot be imposed. By its very nature it must come about with voluntary participation at the grassroots level based on common sense approaches. Poor farmers must be involved in developing plans and projects that reflect their own experience, needs, priorities and available resources. It is for this reason that Oxfam

America has deliberately chosen to focus our development work in Ethiopia on small, practical interventions with local farmer organizations. We believe this approach has yielded solid and sustainable gains.

Oxfam America welcomes this opportunity to share with the Committee our experience regarding development assistance to Ethiopia. I would like, if I may, to add a cautionary note. What is possible for a small private non-governmental organization like Oxfam America to achieve in Ethiopia may be quite different from what a large bilateral donor such as the U.S. Government may be able to do. Moreover, any decision on the part of the U.S. Government to fund long-term development assistance to Ethiopia must take into account a range of important bilateral issues. The case for long-term development as the only alternative to continuous famine relief is compelling. At the same time, Oxfam America believes that any long-term aid which the U.S. Government may offer Ethiopia should be linked to clear progress on key issues such as resolving the armed conflicts, improving human rights conditions, and liberalizing economic policies that undercut self-reliance and perpetuate Ethiopia's grinding poverty. The U.S. Government should take advantage of Ethiopia's interest in Western aid and improved ties to press for changes that, together with grassroots agricultural development, offer the only hope of ending Ethiopia's structural food deficit and recurrent famine crises.

Senator GORE. Our next witness is Tom Getman, vice president for government relations, World Vision. Welcome, Mr. Getman.

STATEMENT OF TOM GETMAN, DIRECTOR, GOVERNMENT RELATIONS, WORLD VISION RELIEF & DEVELOPMENT, INC.

Mr. GETMAN. Mr. Chairman, I should correct the record. First of all, you have promoted me to vice president. Actually, I am the director of government relations for World Vision United States. Our vice president works and resides in Geneva. I am pleased to appear before you to share our program information and concerns of our organization, and in particular the potential for sustainable agricultural devlopment in Ethiopia in spite of political or military exigencies.

Our humanitarian mandate compels us to find a way to do sustainable development. World Vision's significant involvement in positive development activities in Ethiopia began almost 15 years ago in 1975. Building on an historic child sponsorship approach, World Vision has since developed a wide array of small- and medium-scale development projects alongside its traditional child sponsorship activities and large-scale relief and rehabilitation interventions. These development projects have taken the form of small-scale community development, medium-scale integrated community development, and sectorally specific projects in areas such as agriculture, environmental rehabilitation, primary health care, water development, income generation, and infrastructure building. In 1989 alone, World Vision assisted over 500,000 Ethiopians through these development programs. In fiscal year 1990 alone, a projected cash budget of $8 million in United States dollars will be allocated for Ethiopia. Approximately $6.6 million of this will support 165 development projects, of which 148 will be small-scale community development projects funded with individual donor child sponsorship funds while the remaining 17 will be funded from nonsponsorship sources.

World Vision has a foundational commitment to a community-based approach to development which not only takes into account specific communities felt needs but actively involves them in the development process. Over the past few years World Vision has begun to strategically cluster formerly isolated child sponsorship-funded community development projects with small-scale sectoral development components in order to take advantage of the synergistic impact on a larger geographical area which can be achieved from networking these development projects. World Vision's integrated community development projects are funded by groups of individuals sponsoring children and some nonsponsorship private funds. Larger scale integrated community rehabilitation and development projects are often funded by bilateral donors such as Canadian International Development Agency (CIDA), the U.S. Agency for International Development, and private corporate donors.

In Ethiopia, World Vision has begun to cluster its child-sponsorship projects around a number of sectoral interventions. These include natural resource management activities in the form of revolving agricultural inputs schemes [RAILS]; agricultural extension training in improved agricultural practices such as crop rotation,

row cropping, composting, and grain storage techniques; and environmental rehabilitation in the form of training in and actual implementation of reforestation and soil and water conservation. Also, project networking has begun on health-related interventions in the form of water and sanitation development, and primary health care initiatives. Some clustering has also occurred in World Vision's small-scale income generation projects.

World Vision has experienced varying success in the implementation of sectoral development in Ethiopia. In general, projects focused on primary health care, water and soil conservation, sanitation, and small-scale, individual family income generation have fared the best. In our primary health care initiatives, World Vision has assisted in training 122 community health workers, 95 traditional birth attendants, and 114 community health facilitators in local communities to implement and train community members in nutrition education, immunization, and oral rehydration therapy—to combat diarrheal diseases. This community-based approach to primary health care has increased community ownership of the interventions and, thus their chance of long-term sustainability.

Although perhaps not as widespread, World Vision's water development initiatives have also met with a fair amount of success, particularly considering budgetary constraints. I have a map which shows the region where we have done most of our large-scale development projects. And I have some pictures for you, too, that I will give to your staff.

Senator GORE. Are those your pictures?

Mr. GETMAN. No, these in front of us are not. But similarly, we worked in an area called Ansokia which was one of the most highly publicized in southern Wollo during the last famine in 1984–85. We were feeding 100,000 people a day there. And there were many deaths. Today it is flourishing, beautiful garden spot that is famine resistant. The pictures will point that out.

At present, there are 12 successfully operational shallow wells in Ethiopia; this represents a 55-percent success rate in shallow well drilling. Deep-well drilling has also achieved a 65-percent success rate, or 24 wells. Given the nature of hydrology engineering, a 55- to 65-percent success rate is considered very good. World Vision hopes to continue this intervention.

World Vision's small-scale income generation schemes focus on assisting individual families have been particularly successful. The lack of adequate income is a common problem in many of the communities in which World Vision operates. From 1975 through 1989, World Vision has assisted 4,548 families through a wide range of small-scale income generation projects, mainly through providing initial inputs to small business. In small agricultural projects, similar to what Mr. Buchanan has described.

These small businesses have included weaving, tailoring, leather working, carpet and mat making, wood and metal working, animal fattening, bakeries, beekeeping, vegetable gardening, poultry farming, and flour milling. Some small retail stores have been also started. The overall success rate for these small businesses has been between 50 to 75 percent. However, bakeries and flour mills, which are owned by the community rather than individual families, have an 80- to 100-percent success rate.

World Vision has been very successful in reforestation and soil and water conservation projects as well. Some of these projects have been in conjunction with individual families or communities; others have been implemented alongside the Ministry of Agriculture in government plots. World Vision has been able to plant over 22.7 million trees—with a 70-percent survival rate—and has constructed 1,589 kilometers of soil and conservation works—terraces and bunds—since 1986. In addition, 1.2 million microbasins have been dug. Tree plantings in government-controlled forests are intended to be permanent and provide long-term soil and water conservation benefits while plantings in local community forests provide farmers with a variety of trees for fuel, construction materials, food, animal forage, and soil conservation.

World Vision's revolving agricultural inputs loan scheme—or RAILS—which grew out of World Vision's earlier free distribution of seeds and animals to farmers during the 1984–86 Ethiopian drought, has had mixed results thus far. The RAILS intervention seeks to loan farmers agricultural inputs such as seeds, tools, and draught animals which will later be paid for by the farmer though an inkind or cash payment. This inkind and/or cash payment will then be used to assist another farmer. Since 1988, World Vision has provided these agricultural inputs to 33,329 farm family households. However, the first year of the intervention indicated that such interventions may be highly dependent on a sufficient harvest; while in Omosheleko in 1988, a good harvest allowed 94 percent of the farmers in that region to repay their loans, a poor harvest in Mehal Meda precipitated only a 1-percent repayment in that area.

Results from agricultural extension training projects have also been mixed. During 1988–89, 408 farmers involved in World Vision projects adopted improved agricultural practices, including crop rotation, row cropping, composting, and grain storage techniques. These farmers will act as change agents in their own communities, training other farmers to use the improved agricultural practices. However, for the large population of subsistence farmers who cannot afford to risk a harvest by implementing new agricultural practices, agricultural techniques such as crop rotation or new and improved strains of seeds must be proven to work before they are adopted. This is particularly true in drought years. Military interventions are near at hand. Some success has been achieved by using food for work interventions to teach farmers new soil and water conservation techniques; that is, World Vision pays farmers inkind with needed food for their labor on agricultural plots where terracing and other soil and water conservation techniques are being implemented.

The conditions within Ethiopia which impede foreign aid development programs are numerous. First, civil strife between the EPLF in Eritrea, the TPLF in Tigray, and the Mengistu government continues to disrupt harvests in those areas of the country. Government resources, largely provided from outside allies, are funneled toward combating the insurgents. Security issues complicate the picture as well; large sections of the population in the north are cut off from the rest of the country, thus disrupting trade. In addition, these northern populations often are forced

south by the fighting, creating the need for massive refugee assistance in areas where the land is already unable to support the indigenous population. The battle for Massawa further exacerbates the problems, as Congressmen Tony Hall and Frank Wolf pointed out in the Washington Post on February 21. The instability of such situations makes long-term development of any kind nearly impossible. The urgency is reinforced by the attached telex to my prepared statement from CRDA, the Christian Relief and Development Agency, which is a consortium in Ethiopia.

Second, the Government of Ethiopia's restrictive economic policies also make sustainable agricultural development difficult. Although the vast majority of agricultural production takes place on small family farms, government policies dictate that the lion's share of government funds for agriculture be spent on large, inefficient collective farms. Lack of incentives for agricultural production impede the agricultural development. Currently, the Agricultural Marketing Corporation, a paragovernmental organization, regularly fixes prices on agricultural commodities at an artifically low rate in order to ensure that urban dwellers can buy cheap grain. Price fixing exacerbates the poverty of the rural population and provides a strong disincentive for surplus agricultural production as well. Even if price fixing was to be lifted, the current dearth of a consumer goods market economy would prolong the trade problem.

Third, large-scale funding for development activities is scarce. Ethiopia is one of the poorest countries in the world. The 13 years of the Marxist government's program of widespread forced "villagization" and economic disincentives—such as price fixing on agricultural commodities—have only augmented this situation. Even where agricultural development has been attempted by the Government, lack of available funding has made the task all but impossible. For instance, the Ministry of Agriculture [MOA] has attempted to train farmers in new agricultural practices; however, with a ratio of 1 MOA representative for every 2,500 farmer families, there is little chance of immediate change.

In addition, there is a lack of external funding for development, which almost all witnesses have talked about. A number of governments and multilaternal donors have barred development assistance to Ethiopia. For some, like the United States Government, as you know, this has been due to the fact that the Ethiopian Government has never reimbursed the United States for property seized during the revolution 13 years ago. Other large donors have found the intransigence of the Government of Ethiopia and/or its Marxist policies such as villagization too odious. This pattern has left little large-scale funding available for agricultural, or any other type of development program.

Fourth, as noted above, natural resource management initiatives which have been implemented—such as agricultural extension training and agricultural input loans—have often been impeded by the reluctance of farmers to accept new agricultural practices. Approximately, 86 percent of the Ethiopian population are farmers, many of them subsistence farmers who depend on each harvest for mere survival. That's why the Ansokia illustration is an important one. They follow traditional, labor-intensive methods of farming,

including hand broadcasting of seeds, harvesting by hand scythes, threshing with oxen, and hand winnowing, which produce significant postharvest grain losses. Traditional methods of grain storage—either in a clay pot in the ground or a basket hung from the ceiling or outside—invite insect infestation and further losses. In addition, fields are worked extensively, with no fallow years or crop rotation, which depletes the soil of nutrients. Deforestation as a result of fuel needs amplifies the amount of top soil which is washed away. Dung and straw which, with Ethiopia's large livestock herds, could be a significant resource to renew these nutrients is usually collected and dried for sale as a fuel source. Basic changes in agricultural practice could greatly cut these losses. We have noticed that farmers will accept new methods or crop strains which are proven to work in their fields, but are very cautious with risking their crop to the vicissitudes of untried practice.

Also, as noted above, a further hindrance to the acceptance of new agricultural practices is the recurrent cycle of droughts in East Africa which make growing crops difficult even with new practices. In addition, drought conditions tend to sabotage agricultural loan schemes, which rely upon repayment inkind.

Fifth, lack of infrastructure in Ethiopia exacerbates the difficulties surrounding implementing sustainable agricultural development. The average Ethiopian farmer lives 2 days' walk from the nearest road. This means that all excess crops which are produced have to be hauled by animal or the human back. This seriously impedes the trade of agricultural commodities and provides a disincentive to producing surplus crops.

In the midst of this discouraging situation, however, there are a number of areas of hope. As noted above, farmers are receptive to new agricultural practices if it can be shown that they work. The Ethiopian peasant is a good farmer if given adequate climate, agricultural conditions, and incentives. Ethiopian communities are often highly organized as groups; this assists in both the development training and implementation of development projects. The Government of Ethiopia's "villagization" program, although onerous in its methodolgy, has brought groups of people together in one place, making it easier to transfer knowledge to more farmers. Even the difficult drought conditions and the diaspora of refugees caused by civil strife can create conditions where "food for work" programs can help disseminate reforestation, and water and soil conservation practices. There is also a long history of private voluntary organization cooperation in Ethiopia; the relief work precipitated by the major droughts of the 1980's have only augmented coordination between PVO's. Finally, the Government of Ethiopia itself is committed to reforestation and soil and water conservation, as is evident in the previously mentioned program of the Ministry of Agriculture.

As you know, Ethiopia is currently barred from receiving United States funding for any development activities under the Brooke-Hickenlooper Act. We would like to strongly suggest that this position be reviewed, especially if a joint Soviet/United States encouraged "food truce" becomes a reality. Any intelligent discussion of the potential for creating sustainable development and famine resistance within Ethiopia, and particularly in the case of agricultur-

al development, must address the scope of the problem, and the necessity of providing large-scale funding to implement programs which will begin to reverse basic widespread trends—example, 1 million metric tons/year food deficit, deforestation, soil erosion, and overall decrease in the fertility of the soil. While we applaud the U.S. Government's relief response to the several droughts which have plagued Ethiopia over the last decade, we submit that, given the drought cycle of east Africa and the increasing ratio of population to usable hectares, relief efforts are not enough to stem the tide of widespread famine. Preventative measures are needed.

Once development assistance is available, "food for work" and monetization programs can provide an opportunity to meet two needs. First, they can provide a forum for training Ethiopian farmers in new agricultural practices which they can implement in their own fields. Second, these programs will furnish needed foodstuffs to malnourished people while helping them to retain their dignity; we will be giving them not only fish, but the fishing pole, so to speak.

Development assistance funds could also be used to encourage environmental rehabilitation measures such as reforestation and soil and water conservation. Coordination of such projects with agricultural extension training programs for farmers would greatly augment the benefits of these programs for the individual farmer. An added advantage of this environmental rehabilitation focus would be that it already has the approval of the Ministry of Agriculture.

Development assistance funds given to these types of projects can encourage positive and productive agricultural strategies which not only increase agricultural production, but also empower individuals to feed themselves and to improve their quality of life.

Any development measures which seek to be sustainable must incorporate not only community participation, but an integrated, holistic approach in sectoral development. For instance, health programs without water and sanitation components defeat the very end at which they are aiming: the alleviation and eventual eradication of disease. In agricultural development, specifically, the introduction of better crop strains must go hand in hand with the development of water catchments to provide enough irrigation water and forestation measures to counter soil depletion from erosion.

World Vision suggests that careful attention be paid to the integration of both relief and development in Ethiopia. In many cases, it is difficult to ascertain where relief ends and development begins. For instance, the Ethiopia AgPak program carried out in 1988 and 1989 provided seeds and tools to populations dislocated by famine in order to assist them in regaining their livelihood. This type of program naturally leads into a developmental approach; it is a short step from handing out seeds and tools to showing people how to use them more effectively.

To date, there are over 40 U.S. private voluntary organizations alone working in Ethiopia who are members of InterAction. AID-funded relief and rehabilitation work in Ethiopia has been carried out in the last few years by a number of these organizations including Save the Children, Catholic Relief Services, and World Vision. Extensive relief and development work has also been carried out

by CARE, Food for the Hungry, and many indigenous PVO's. Many of these private voluntary organizations have considerable grassroots experience in development activities within the culture and represent a significant resource for development.

Mr. Chairman, thank you once again for this opportunity. We in World Vision are open to further discussion about the realities of our work in Ethiopia. I am pleased to entertain your questions this morning. I have added an article from one of our photographers to get more to the core of the heartfelt problems, and it is entitled "Ansokia Tears," dated May 26, 1989.

Senator GORE. I have it. Thank you.

[The prepared statement of Mr. Getman, together with attachments, follows:]

PREPARED STATEMENT OF TOM GETMAN

Mr. Chairman, I am pleased to appear before you and the members of the Joint Economic Committee today to share with you program information and concerns of our organization, World Vision, regarding relief and development needs in Ethiopia, and in particular, the potential for sustainable agricultural development in that country.

Types of Aid Programs Provided

World Vision's significant involvement in positive development activities in Ethiopia began almost 15 years ago in 1975. Building on an historic child sponsorship approach, World Vision has since developed a wide array of small- and medium-scale development projects alongside its traditional child sponsorship activities and large-scale relief and rehabilitation interventions. These development projects have taken the form of small-scale community development, medium-scale integrated community development, and sectorally-specific projects in areas such as agriculture, environmental rehabilitation, primary health care, water development, income generation, and infrastructure building. In 1989 alone, World Vision assisted over 500,000 Ethiopians through these development projects. In fiscal year 1990, a projected cash budget alone of U.S. $8 million will be allocated for Ethiopia. Approximately $6.6 million of this will support 165 development projects, of which 148 will be small-scale community development projects funded with individual donor child sponsorship funds while the remaining 17 will be funded from non-sponsorship sources.

While World Vision has a foundational commitment to a community-based approach to development which not only takes into account specific communities felt needs but actively involves them in the development process, over the past few years World Vision has begun to strategically cluster formally isolated child sponsorship-funded community development projects

with small-scale sectoral development components in order to take advantage of the synergistic impact on a larger geographical area which can be achieved from networking these development projects. World Vision's integrated community development projects are funded by groups of individuals sponsoring children and some non-sponsorship private funds. Larger-scale integrated community rehabilitation and development projects are often funded by bilateral donors such as Canadian International Development Agency (CIDA), the U.S. Agency for International Development, and private corporate donors.

In Ethiopia, World Vision has begun to cluster its child-sponsorship projects around a number of sectoral interventions. These include natural resource management activities in the form of revolving agricultural inputs schemes (RAILS); agricultural extension training in improved agricultural practices such as crop rotation, row cropping, composting, and grain storage techniques; and environmental rehabilitation in the form of training in and actual implementation of reforestation and soil and water conservation. Also, project networking has also begun on health-related interventions in the form of water and sanitation development, and primary health care initiatives. Some clustering has also occurred in World Vision's small-scale income generation projects.

Success Rates of Current Aid Efforts

World Vision has experienced varying success in the implementation of sectoral development in Ethiopia. In general, projects focussed on primary health care, water and soil conservation, sanitation, and small-scale, individual family income-generation have fared the best. In its primary health care initiatives, World Vision has assisted in training 122 community health workers, 95 traditional birth attendants, and 114 community health facilitators in local communities to implement and train community members in nutrition education, immunization, and oral rehydration therapy (to combat diarrheal diseases). This community-based approach to primary health care has increased community ownership of the interventions and, thus their chance of long-term sustainability.

Although perhaps not as widespread, World Vision's water development initiatives have also met with a fair amount of success, particularly considering budgetary constraints. At present, there are 12 successfully operational shallow wells in Ethiopia; this represents a 55% success rate in shallow well drilling. Deep well drilling has also achieved a 65% success rate, or 24 wells. (Given the nature of hydrology engineering, a 55-65% success rate is considered very good.) World Vision hopes to continue this intervention.

World Vision small-scale income generation schemes focus on assisting individual families have been particularly successful. The lack of adequate income is a common problem in many of the communities in which World Vision operates. From 1975 through 1989, World Vision has assisted 4,548 families through a wide range of small-scale income generation projects, mainly through providing initial inputs to small business. These small businesses have included weaving, tailoring, leather-working, carpet and matmaking, wood- and metal-working, animal fattening, bakeries, beekeeping, vegetable gardening, poultry farming, and flour milling. Some small retail stores have also been started. The overall success rate for these small businesses has been between 50-75%. However, bakeries and flour mills, which are owned by the community rather than individual families, have a 80-100% success rate.

World Vision has been very successful in reforestation and soil and water conservation projects as well. Some of these projects have been in conjunction with individual families or communities; others have been implemented alongside the Ministry of Agriculture in government plots. World Vision has been able to plant over 22.7 million trees (with a 70% survival rate) and has constructed 1,589 kilometers of soil and conservation works (terraces and bunds) since 1986. In addition, 1.2 million microbasins have been dug. Tree plantings in government-controlled forests are intended to be permanent and provide long-term soil and water conservation benefits while plantings in local community forests provide farmers with a variety of trees for fuel, construction materials, food, animal forage, and soil conservation.

World Vision's revolving agricultural inputs loan scheme (or RAILS), which grew out of World Vision's earlier free distribution of seeds and animals to farmers during the 1984-86 Ethiopian drought, has had mixed results thus far. The RAILS intervention seeks to loan farmers agricultural inputs such as seeds, tools, and draught animals which will later be paid for by the farmer through an in-kind or cash payment. This in-kind and/or cash payment will then be used to assist another farmer. Since 1988, World Vision has provided these agricultural inputs to 33,329 farm family households. However, the first year of the intervention indicated that such interventions may be highly dependent on a sufficient harvest: while in Omosheleko in 1988, a good harvest allowed 94% of the farmers in that region to repay their loans, a poor harvest in Mehal Meda precipitated only a 1% repayment in that area.

Results from agricultural extension training projects have also been mixed. During 1988-89, 408 farmers involved in World Vision projects adopted improved agricultural practices, including crop rotation, row cropping, composting, and grain storage techniques. These farmers will act as change agents in their own communities, training other farmers to use the improved agricultural practices. However, for the large population of subsistence farmers who cannot afford to risk a harvest by implementing new agricultural practices, agricultural techniques such as crop rotation or new and improved strains of seeds must be proven to work before they are adopted. This is particularly true in drought years. Some success has been achieved by using food for work interventions to teach farmers new soil and water conservation techniques; that is, World Vision pays farmers in-kind with needed food for their labor on agricultural plots where terracing and other soil and water conservation techniques are being implemented.

Conditions in Ethiopia Which Impede/Assist Aid Programs

The conditions within Ethiopia which impede foreign aid development programs are numerous. *Firstly*, civil strife between the EPLF in Eritrea, the TPLF in Tigray, and the Mengistu government continues to disrupt harvests in those areas of the country. Government resources, largely provided from outside allies, are funneled towards combatting the insurgents. Security

issues complicate the picture as well: large sections of the population in the north are cut off from the rest of the country, thus disrupting trade. In addition, these northern populations often are forced south by the fighting, creating the need for massive refugee assistance in areas where the land is already unable to support the indigenous population. The battle for Massawa further exacerbates the problems, as Congressmen Tony Hall and Frank Wolf pointed out in The Washington Post on February 21. The instability of such situations makes long-term development of any kind nearly impossible.

Secondly, the Government of Ethiopia's restrictive economic policies also make sustainable agricultural development difficult. Although the vast majority of agricultural production takes place on small, family farms, government policies dictate that the lion's share of government funds for agriculture be spent on large, inefficient collective farms. Lack of incentives for agricultural production impede the agricultural development. Currently, the Agricultural Marketing Corporation, a para-governmental organization, regularly fixes prices on agricultural commodities at an artificially low rate in order to ensure that urban dwellers can buy cheap grain. Price fixing exacerbates the poverty of the rural population and provides a strong disincentive for surplus agricultural production as well. Even if price fixing was to be lifted, the current dearth of a consumer goods market economy would prolong the trade problem.

Thirdly, large-scale funding for development activities is scarce. Ethiopia is one of the poorest countries in the world. The thirteen years of the Marxist government's program of widespread forced "villagization" and economic disincentives (such as price fixing on agricultural commodities) have only augmented this situation. Even where agricultural development has been attempted by the Government, lack of available funding has made the task all but impossible. For instance, the Ministry of Agriculture (MOA) has attempted to train farmers in new agricultural practices; however, with a ratio of 1 MOA representative for every 2,500 farmer families, there is little chance of immediate change.

In addition, there is a lack of external funding for development. A number of governments and multilateral donors have barred development assistance to Ethiopia. For some, like the U.S. Government, as you know, this has been due to the fact that the Ethiopian government has never reimbursed the United States for government property seized during the revolution 13 years ago. Other large donors have found the intransigence of the Government of Ethiopia and/or its Marxist policies such as villagization too odious. This pattern has left little large-scale funding available for agricultural, or any other type of development program.

Fourthly, as noted above, natural resource management initiatives which have been implemented (such as agricultural extension training and agricultural input loans) have often been impeded by the reluctance of farmers to accept new agricultural practices. Approximately 86% of the Ethiopian population are farmers, many of them subsistence farmers who depend on each harvest for mere survival. They follow traditional, labor-intensive methods of farming, including hand broadcasting of seeds, harvesting by hand scythes, threshing with oxen, and hand winnowing, which produce significant post-harvest grain losses. Traditional methods of grain storage -- either in a clay pot in the ground or a basket hung from the ceiling or outside -- invite insect infestation and further losses. In addition, fields are worked extensively, with no fallow years or crop rotation, which depletes the soil of nutrients. Deforestation as a result of fuel needs amplifies the amount of top soil which is washed away. Dung and straw which, with Ethiopia's large livestock herds, could be a significant resource to renew these nutrients is usually collected and dried for sale as a fuel source. Basic changes in agricultural practice could greatly cut these losses. World Vision has noticed that farmers will accept new methods or crop strains which are *proven* to work in their fields, but are very cautious with risking their crop to the vicissitudes of untried practices.

Also, as noted above, a further hinderance to the acceptance of new agricultural practices is the recurrent cycle of droughts in East Africa which make growing crops difficult even with new

practices. In addition, drought conditions tend to sabotage agricultural loan schemes, which rely upon repayment in-kind.

Fifthly, lack of infrastructure in Ethiopia exacerbates the difficulties surrounding implementing sustainable agricultural development. The average Ethiopian farmer lives two-days walk from the nearest road. Goods must be transported on either animal or human backs. This seriously impedes the trade of agricultural commodities and provides a disincentive to produce surplus crops.

In the midst of this discouraging situation, however, there are a number of areas of hope. As noted above, farmers *are* receptive to new agricultural practices *if* it can be shown that they work. The Ethiopian peasant is a good farmer if given adequate climate, agricultural conditions, and incentives. Ethiopian communities are often highly organized as groups; this assists in both the development training and implementation of development projects. The Government of Ethiopia's "villagization" program, although onerous in its methodology, has brought groups of people together in one place, making it easier to transfer knowledge to more farmers. Even the difficult drought conditions and the diaspora of refugees caused by civil strife can create conditions where "food for work" programs can help disseminate reforestation, and water and soil conservation practices. There is also a long history of private voluntary organization cooperation in Ethiopia; the relief work precipitated by the major droughts of the 1980's have only augmented coordination between PVOs. Finally, the Government of Ethiopia itself is committed to reforestation and soil and water conservation, as is evident in the previously mentioned program of the Ministry of Agriculture.

Potential for New Forms of Aid

As you know, Ethiopia is currently barred from receiving U.S. Government funding for any development activities under the Brook-Hickenlooper Act. We would like to strongly suggest

that this position be reviewed, especially if a joint Soviet/U.S. encouraged "food truce" becomes a reality. Any intelligent discussion of the potential for creating sustainable development within Ethiopia, and *particularly* in the case of agricultural development, must address the scope of the problem and the necessity of providing large-scale funding to implement programs which will begin to reverse basic widespread trends (ex., ..1 million metric tons/year food deficit, deforestation, soil erosion, and overall decrease in the fertility of the soil). While we applaud the U.S. Government's relief response to the several droughts which have plagued Ethiopia over the last decade, we submit that, given the drought cycle of East Africa and the increasing ratio of population to useable hectares, relief efforts are *not enough* to stem the tide of widespread famine. Preventative measures are needed.

Once development assistance is available, "food for work" and monetization programs can provide an opportunity to meet two needs. First, they can provide a forum for training Ethiopian farmers in new agricultural practices which they can implement in their own fields. Second, these programs will furnish needed foodstuffs to malnourished people *while helping them to retain their dignity*; we will be giving them not only the fish, but the fishing pole, so to speak.

Development assistance funds could also be used to encourage environmental rehabilitation measures such as reforestation and soil and water conservation. Coordination of such projects with agricultural extension training programs for farmers would greatly augment the benefits of these programs for the individual farmer. An added advantage of this environmental rehabilitation focus would be that it already has the approval of the Ministry of Agriculture.

Development assistance funds given to these types of projects can encourage positive and productive agricultural strategies which not only increase agricultural production, but also empower individuals to feed themselves and to improve their quality of life.

How Aid Programs Can Be Better Integrated

Any development measures which seek to be sustainable must incorporate not only community participation, but an integrated, holistic approach in sectoral development. For instance, health programs without water and sanitation components defeat the very end at which they are aiming: the alleviation and eventual eradication of disease. In agricultural development, specifically, the introduction of better crop strains must go hand in hand with the development of water catchments to provide enough irrigation water and forestation measures to counter soil depletion from erosion.

World Vision suggests that careful attention be paid to the integration of *both* relief and development in Ethiopia. In many cases, it is difficult to ascertain where relief ends and development begins. For instance, the Ethiopia AgPak program carried out in 1988 and 1989 provided seeds and tools to populations dislocated by famine in order to assist them in regaining their livelihood. This type of program naturally leads into a developmental approach; it is a short step from handing out seeds and tools to showing people how to use them more effectively.

Development initiatives should attempt to integrate multiple sectoral facets. For instance, "food for work" and monetization programs should seek to implement multiple natural resource management interventions including the construction of water catchments; the practice of letting land lie fallow, crop rotation, and using available dung to restore nutrients; and the planting of trees to inhibit soil erosion. In addition, small-scale income generation schemes could also provide a financial basis from which to expand agricultural production. Drilling of wells could provide water in drought conditions for crops and people. Agricultural development could also be correlated with concurrent health initiatives which emphasize growing nutritious foods. Each of these sectoral aspects of development could be used creatively to enhance the success of each other.

Strengths of Private Voluntary Organizations, Direct Bilateral Aid, and Multilateral Organizations

To date, there are over 40 U.S. private voluntary organizations alone working in Ethiopia who are members of InterAction. A.I.D.-funded relief and rehabilitation work in Ethiopia has been carried out in the last few years by a number of these organizations including Save the Children, Catholic Relief Services, and World Vision. Extensive relief and development work has also been carried out by CARE, Food for the Hungry, and many indigenous PVOs. Many of these private voluntary organizations have considerable grass-roots experience in development activities within the culture and represent a significant resource for development.

Many private voluntary organizations are established and have a long-term commitment to, and track record with, relief and development projects in Ethiopia. They have an organizational infrastructure within the country capable of carrying out development activities already in place. The U.S. private voluntary organizations working within Ethiopia have developed ties with specific communities and have already mobilized rural communities to carry out small- and medium-scale sectoral development. For instance, World Vision has had a field office in Ethiopia since 1975, the staff of which are currently all Ethiopian nationals. Since inception, we have been implementing small- to medium-scale community-based development projects in conjunction with our child sponsorship initiatives which have ranged from health interventions to water initiatives and training in improved agricultural practices. Other organizations, such as those involved in the Christian Relief and Development Agency (a consortium of PVOs in Ethiopia), have carried out quality relief and development work for many years, despite the financial, logistical, and political impediments that exist.

Unlike government or even multilateral development, private voluntary organizations have the advantage of being disassociated from ties to any specific political programs. This is of particular advantage in Ethiopia, in the context of a Marxist-Leninist government system. The tendency of private voluntary organization to work "from the ground up" -- from the grassroots

level -- rather than "from the top down" like governmental and multi-lateral donors allows them considerable flexibility and fewer political entanglements. In short, private voluntary organizations are strategically positioned to implement development in difficult political context like Ethiopia.

Mr. Chairman, thank you once again for this opportunity. We in World Vision are open to further discussion about the realities of our work in Ethiopia. I am pleased to entertain your questions this morning.

THE WASHINGTON POST 2/21/90

Tony Hall and Frank Wolf

Ethiopia's Only Hope

Once again, the nation of Ethiopia has become synonymous with deadly famine. Six years ago the world saw through a television lens the bloated bellies and finger-thin limbs of its victims. The face of death on the body of a child is an image etched in our memories. Now, nearly 5 million people in the northern provinces of Ethiopia are again facing the immediate risk of death from famine-related causes.

This calamity, rooted in lengthy civil wars and exacerbated by recent drought, did not catch the international community by surprise. The famine was forecast, and steps were initiated to prevent it. Under diplomatic pressure from the United States and the United Nations, both the Ethiopian government and the insurgents seemed receptive to "corridors of safe passage" through which humanitarian aid could be transported into contested areas.

But the situation worsened dramatically in the past week. The Eritrean People's Liberation Front began a long-anticipated offensive throughout Eritrea. The fighting is reported to be bloody and intense, making any effort to deliver food to the famine victims impossible. Most of the 5 million imperiled civilians live in areas where the fighting is heaviest.

One major target of the EPLF offensive is the port of Massawa. Massawa had been the main port for the delivery of emergency food and other relief supplies intended for millions of civilians. Some of this food, already unloaded at the port, was destroyed in the fighting. This new offensive may go on for months, rendering the port of Massawa useless.

The 5 million civilians at risk receive help in two ways: either the food, medicine and other supplies are transported from Sudan into western Ethiopia or the supplies come through Massawa into eastern Ethiopia.

The western supply route remains open, and it must operate at maximum capacity. However, the western route, even when operating at maximum efficiency, is too distant to reach all of the 5 million in need.

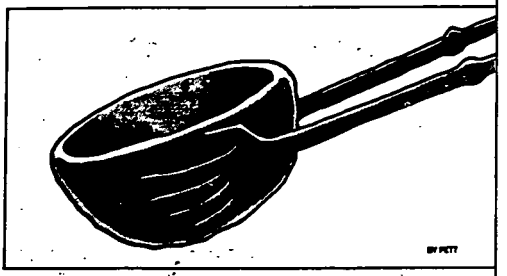
We were in Ethiopia in 1984. We know what will happen—soon—if the eastern route remains closed: hundreds of thousands of people will begin the tortuous migration to camps in search of food; the United States and other governments will spend tens of millions of dollars airlifting supplies to these camps, and—despite our best efforts—hundreds of thousands, maybe millions, will perish. Because they are the weakest, infants and children will die in the largest numbers.

The United States has been monitoring the evolution of this famine since early in the fall and has acted quickly, along with other donors, to dispatch thousands of tons of food to Ethiopia. We have already delivered nearly 30,000 tons of food, and another 140,000 tons are scheduled to arrive between now and June. But the intense fighting jeopardizes distribution of this aid.

At a time when all sides to the conflict appear to have decided that heavy civilian losses are an acceptable price to pay for military victory, what can be done to save innocent lives?

Now is the time for an 11th-hour humanitarian offensive, led by President Bush, joined by President Gorbachev and working through the U.N. Security Council. Nothing less than a full-scale international assault against hunger in Ethiopia, led by the superpowers and the United Nations, has a chance of success.

A "food truce," through which white-flagged relief convoys would cross battle lines to reach civilians, could be arranged. Redirecting food through the port of Assab and rerouting the "corridors of safe passage" to move to the south of heavy fighting would be possible. The United Nations and private relief agencies could assure the warring factions that only food and relief supplies will move along these corridors.



Most of the results of the thaw in the Cold War have thus far been political: new governments in Czechoslovakia and Poland, steps toward German reunification and an end to one-party rule in the Soviet Union. Here is the chance—indeed the duty—to use the warming of relations for humanitarian ends. It is our duty, because, as former president Reagan said, a hungry child knows no politics.

Together, the U.S. and Soviet governments should make this issue a priority and declare an international offensive against famine in Ethiopia. Millions of people all over the world, not just in Eastern Europe, could benefit from the change in superpower relations. It is the responsibility of the superpowers to make that change felt in Ethiopia.

Tony Hall is a Democratic representative from Ohio and chairman of the House Select Committee on Hunger. Frank Wolf is a Republican representative from Virginia and also serves on the committee.

INBOUND MESSAGE #: 373163
Received: WED 21FEB90 5:43 AM: 43 Lines: 1238 Characters
FROM: Off System
To:

264706 WORV UR

RCA FEB 21 08:39

RCA THRUDATA MSG 5851 TO 275335 RCVD FEB 21 08:35
275335 WORV UR

20 FEBRUARY 1990

TO ALL DONORS

CRDA WITH A MEMBERSHIP OF 63 CHURCHES/NGOS IS DEEPLY CONCERNED WITH THE PRESENT SITUATION PREVAILING IN ETHIOPIA.

IT IS NOW ESTIMATED THAT UP TO 3 MILLION PEOPLE ARE AFFECTED BY FAMINE AND THEIR SITUATION IS FURTHER EXACEBRATED BY THE MILITARY CONFLICT IN THE NORTH. TO MOVE FOOD INTO THE BELEAGUERED AREA FROM EITHER MASAWA OR ASSAB IS VIRTUALLY IMPOSSIBLE.

CRDA MEMBERSHIP APPEALS TO ALL SIDES TO REALISE AS A MATTER OF URGENCY A 'CORRIDOR OF PEACE' FROM BOTH THE SOUTH AND THE NORTH.

CRDA MEMBERSHIP ARE SHOCKED AT THE INTERFERENCE WITH THE FOOD AID SHIPS ON THE RED SEA. WE CONDEMN THE RECENT CAPTURE OF THE SVEA ATLANTIC BY THE EPLF AND THE TAKING BY FORCE OF ITS CARGO WHICH CAN ONLY BE DESCRIBED AS AN ACT OF PIRACY.

WE ASK ALL OUR DONORS AS A MATTER OF URGENCY TO EQUALLY CONDEMN SUCH ACTIONS AND TO BRING PRESSURE TO BEAR ON ALL SIDES OF THIS CONFLICT TO FIND A PEACEFUL SOLUTION. IT IS ESSENTIAL THAT CORRIDORS OF PEACE BE ESTABLISHED IMMEDIATELY IF A MAJOR HUMAN TRAGEDY IS TO BE AVOIDED.

CRDA EXECUTIVE COMMITTEE

CC: CHIEF COMMISSIONER - RRC

275335 WORV UR

21307 CRDA ET
MMM
264706 WORV UR
*

Total channel time: 24.5 Seconds:End of Message # 373163

ANSOKIA TEARS

May 26. 1989

I first saw its dusty brown plains in February 1985. It was my first visit to a World Vision feeding center in Ethiopia. I had grown accustomed to the pictures on the TV news so I felt prepared for what I would see. When I arrived I snapped picture after picture of starving emaciated children.

Suddenly I realized I was hiding behind the detachment of a camera. I put the camera away and began to take in what was happening. Within minutes a few tears began to slowly roll down my cheeks It was not like watching the same scenes on TV. I couldn't turn the channel. I was not longer a spectator. The full reality of thousands of children many who would not survive. was only an arm's length away.

Four years later I've come back to Ansokia. As I arrived, I was awestruck. Instead of the dusty brown plains, there were hundreds of acres of green crops and millions of trees. None of these was here the last time I saw the place. They had transformed the Ansokia Valley.

As we drove from the airstrip, concrete-lined irrigation channels wove through green fields. Gone were the brown dust twisters which used to be visible, five or ten at a time, across this several-mile-wide valley.

The best was yet to come - the sounds of happy children. They ran out to meet us from every grass hut, waving, smiling, shouting "Farenge!" (Amharic for "Foreigner!")

As we walked through the streets, we slowly gathered, like pied pipers, a following of at least 150 children. We stopped to talk to them and explained theat we were from World Vision. We asked, "How many of you were in the feeding center in 1985?" At least 90 percent of the children thrust their hands up. I felt chills. There were the very children whose lives we had saved! One ten-year-old boy stood and said "We thank you for lifting us out of poverty ..and for bringing us clean water."

The World Vision project here began in 1984 with a feeding program. Many of the people were too weak to even feed themselves, so the food was prpared for them. Later, as they gained strength, food was given to them to take home Hundreds of acres were irrigated and the local people were taught how to channel the mountain springs onto the farmland. Clean drinking water was piped into the town. A massive reforestation program was begun to restore the valley's ecology.

In the latest mini-drought in Ethiopia in 1988, Ansokia suffered no problems.

Today, the people have caught a vision for how to make their own lives better - the ultimate goal of all good development work. They are organizing themselves with three nearby villages to build a primary school. They are dreaming of a high school next.

We asked a community leader "What do you see for the future?" He replied, "We have almost everything we need. We need to build a mill to grind our flour. Then we won't have to pay someone to do it for us anymore. After that, we need a truck to share among several villages so we can take our produce to market. This will help us earn income. Then we don't need the donor anymore. That is what we want - to not need the donor anymore. But, we will never forget what World Vision has done for us. Before I die, I will tell my son what World Vision did. And he will tell his son. Generation after generation will know what you have done for us - the path of helping others."

True development is not in giving people hand-outs. Hand-outs make welfare cases. We saw from this man that true development has taken place in Ansokia. Nearby villages have begun to organize themselves and start their own projects without any involvement from World Vision; they have seen what the people of Ansokia have done.

Bob Seiple once said about Child Survival and Beyond, "After we've saved a child, we have a moral obligation to stay with that child and to help them have abetter life." Ansokia is a beautiful example of this. We literally saved the lives of hundreds, if not thousands, of these children. Now we're helping to give life more abundantly.

As we climbed back into the plane and lifted off the makeshift dirt runway, the sound of the engines and the sight of that little town perched on the foothills brought back the memory of 1985. A few tears came again, but this time they were tears of joy. I pressed my face to the window out of embarrassment and silently thanked God for letting me have a part in the miracle of Ansokia. It seemed that if this was the only place World Vision ever touched, it would have been worth all the hard work. May we do it again and again in thousands of Ansokias around the world.

A story of hope and gratitude from ...

For years the people got water from the same springs where animals drank. Now they have capped springs and dug wells to provide potable water to each of the 17 villages in the valley.

The Miracle Children of Ansokia

Five years ago, our valley in Ethiopia had dried up and we had no food. It hadn't rained for two years. Almost all of our animals died. Nothing grew. We didn't even have water to drink.

Then it seemed that a miracle happened. God sent some people with trucks and airplanes filled with food and medi-

Photos by Bruce Brander

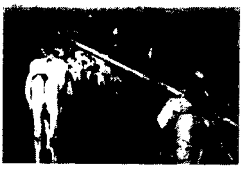
Naru Ahmmed, age 8, recognizes himself in a picture taken during the great famine of the mid 1980s. "Things are different now," he says. "I have plenty to eat, and it is making me feel very strong."

Resta Bashir, 10, plants seedlings from the tree nursery. Five years ago, the valley was bare. Now the people have planted more than 5 million seedlings, and some are already bearing fruit.

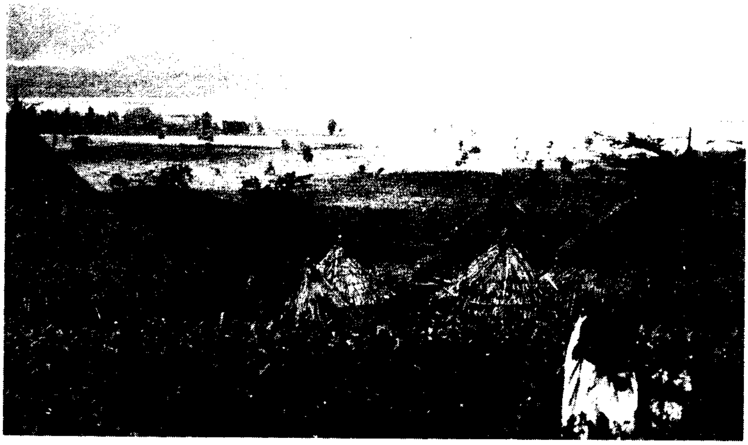
Mame Bekelle, 11, does her family's laundry at a stream. More than 7,000 children in the valley of Ansokia are sponsored, and this helps the families and the entire community.

The village leaders have appointed caretakers who check on the children. If a child needs something, the caretaker arranges for it. Here, a child receives a polio vaccination.

Famine [illegible] Could famine come again? Yes — and it probably will, unless the farmers can grow enough to store food for the future.



When people lose everything they have, it takes a long time to rebuild. That's what's happening now in this valley and other places in Ethiopia.



cine. They set up a camp and began to feed us.

Hundreds of families, thousands of people, from all over our valley gathered at the feeding camp. Many of us just sat there day after day after day. These people fed us three times a day, gave us medicine, and cared for us.

Many months later when it began to rain, they gave us seeds and hoes and grain and sent us back to our homes to start again.

Today our valley is a new place. We have enough to eat and clean water to drink. We don't get sick as often and when we do, we can get help.

But now we must hurry before we have another season without rain. Some of the outsiders have stayed to help us heal our land and learn to help ourselves.

We have much to do. Many farmers need extra food because they can't grow enough to feed their families, and half the children here don't even have enough clothes. Diseases sometimes break out, and many of us can't read.

Still, because of the people from World Vision, our leaders hope that the terrible famine will never happen again. ●

As told to Ron Wilson

The people in the valley have many plans and dreams to improve their lives. But drought and war make life difficult. Pray that the help which the people are receiving may restore the land.

Senator GORE. We will have questions at the end of the panel.

Our third witness is René Lacoste, director of the projects department of the Jules and Paul-Émile Léger Foundation. We welcome you here.

STATEMENT OF RENÉ LACOSTE, DIRECTOR, PROJECTS DEPARMENT, JULES AND PAUL-ÉMILE LÉGER FOUNDATION

Mr. LACOSTE. Thank you, Mr. Chairman, and thank you for inviting a representative of Canadian NGO's. I will not talk very much about my own organization, but about the coalition we have set up for development in Ethiopia.

After the 1984–85 drought, the Canadian organization provided substantial funds for emergency relief to the Ethiopian people and to people of 28 other areas in Africa. It was matched by the department that provided food to the population. But following the intervention, almost all Canadian organizations were confronted with the need to supply another very different type of support. In point of fact, African countries were faced with the threat of a repeated disaster.

Our organization is prepared to provide the food supply, but the long-term goal is long-term development providing food dependency. The country is experiencing extreme drought conditions, and one of the reasons for the drought is deforestation. At the beginning of the century, 48 percent of the Ethiopian territory was covered with forests. Besides the awash situation that jeopardizes all situations for emergency relief——

Senator GORE. Hang on just a second. You said one of the reasons for the drought is the dramatic deforestation throughout this century.

Mr. LACOSTE. Yes.

Senator GORE. Let's expand on that just briefly. Is that because of inland rainfall recycling?

Mr. LACOSTE. Yes, exactly. If you cut the forests, the rainfall diminishes. And, in fact, the present situation in the northern provinces, all of the forests are cut down. If rain doesn't fall it is not because of Communist, Marxist, or captalist regimes. The rain is just not there any more. And that is the reason why in 1974 there was a very severe drought in Ethiopia just before Haile Selassie's fall. One of the problems was deforestation, not the war. The war jeopardized the question of distribution of emergency relief. The war, the civil war, you know, is counterproductive for all of the farmers. But, in fact, one of the major reasons for the drought is deforestation.

Senator GORE. I am wondering if that particular factor is reversible. I want to explore that in a moment. I have spent a great deal of time studying the relationship between environmental destruction and drought. I would like to learn a little bit more about what you are saying. The prevailing winds in Ethiopia are bifurcated. There is the southwest monsoon and the rainy season from mid-June to mid-September, and the northeast wind from the Arabian Desert in the dry season, mid-September to mid-June. Which condition is primarily involved in the relationship between deforestation and drought?

Mr. LACOSTE. I cannot tell you what are the links between the winds and the deforestation or the deforestation and the winds. But, in fact, if you look at this—the present situation in sub-Sahara Africa, not only Ethiopia is the reforestation having to face drought. You know, this whole belt which was a forest several years ago, and now there is cyclical drought in those regions.

Senator GORE. I want to include in the record of this hearing a chronology of Ethiopian droughts and famine as reported by historians in Ethiopia, and this record goes back to 253 B.C. and includes the major droughts and famines that have occurred periodically throughout the last 2,000 years.

[The chronology follows:]

DROUGHT, FOOD SHORTAGES, AND FAMINE IN ETHIOPIA:

A PRELIMINARY REVIEW OF EFFECTS AND POLICY IMPLICATIONS

Patrick Webb
Joachim von Braun

International Food Policy Research Institute
1776 Massachusetts Avenue, N.W.
Washington, D.C. 20036

October 1989

Table 3.1--A chronology of Ethiopian droughts and famines as reported by historians in Ethiopia[a]

Date	Regions Affected	Causes and Severity
253-242 B.C.	Ethiopia	Deduced from low Nile floods.
1066-1072	Ethiopia and Egypt	Deduced from low Nile floods and Egyptian famine.
1252	Ethiopia	First of seven famine years during next thirty years.
1258-59	Ethiopia	Severity unrecorded.
1272-75	Ethiopia	Severity unrecorded.
1435-36	Ethiopia	Severity unrecorded.
1454-68	Ethiopia	Severity unrecorded.
1543-1562	Hararghe	Attributed to God's anger at murder of Emperor Gelawdeos.
1800	Ethiopia	Large human and livestock death toll.
1812-1816	Tigray	Severity unrecorded.
1826-27	Ethiopia	Failure of cotton and grain crops.
1828-29	Shewa	Much human mortality.
1831	Tigray	Severity unrecorded.
1835-38	Tigray and Eritrea	Drought, cholera epidemic; high human and cattle loss.
1864-66	Tigray and Gondar	Heavy human death toll.
1876-78	Tigray and Awash Valley	Heavy livestock death tolls.
1880	Tigray and Gondar	Much loss of livestock.
1888-92	Ethiopia	Drought and spread of rinderpest caused loss of 90 percent cattle and 1/3 human population.
1895-96	Ethiopia	Minor drought. Loss of livestock and human lives.
1899-1900	Ethiopia	Drought deduced from levels of L. Rudolf and low Nile floods.
1913-14	Northern Ethiopia	Lowest Nile floods since 1695. Grain prices said to have risen thirtyfold.
1920-22	Ethiopia	Moderate drought, similar to 1895/96.
1932-34	Ethiopia	Deduced from low level of take. Rudolf in N. Kenya.
1953	Tigray and Wollo	Severity unrecorded.
1957-58	Tigray and Wollo	Rain failure in 1957 with locusts and epidemic in 1958.
1962-63	Western Ethiopia	Very severe.
1964-66	Tigray, Wollo	Undocumented. Said to be worse than 1973/75 droughts.
1969	Eritrea	Estimated 1.7 millions affected.
1971-75	Ethiopia	Sequence of rain failures. Estimated 1/4 million dead. Fifty percent livestock lost in Tigray and Wollo.
1978-79	Southern Ethiopia	Failure of Belg rains.
1982	Northern Ethiopia	Late meher rains.
1984-85	Ethiopia	Sequence rain failure. 8 millions affected. Estimated 1 million dead. Much livestock loss.
1987-88	Ethiopia	Drought of undocumented severity in peripheral regions.

2 or 3 major droughts

Sources: Pankhurst 1984; Wood 1977; ECA 1984; Wolde-Mariam 1984; Woldemichael 1985; Wolkeba 1985; Degefu 1987; Woube 1987; Gizaw 1988; Cedion 1988.

[a] In this compilation exercise, one faces the problem of defining paremeters. Few crises in Ethiopia have resulted from catastrophic events such as floods or earthquakes (although some have certainly been associated with epidemics and the outbreak of warfare). Instead, as has been reported for other parts of Africa, food shortages tend to take on famine proportions after their effects have become cumulative (Lugan 1985, Corbett 1988). In other words, it is hard to say exactly when a food shortage or famine or even a drought actually started, and when it ended. Thus, while some analysts refer to notable crisis years in Ethiopia such as 1958 and 1973, others claim that "during the 20-year period between 1958 and 1977, about 20 percent of the country was under famine conditions each year" (Fraser 1988, 20; see also Wolde Mariam 1984). The analysis in this case clearly depends on the indicators used to define the problem, and on how far back one wishes to extend the chain of causal relationships.

Senator GORE. And it tends to imply that there are conditions that transcend the recent deforestation of the 20th century. I am prone to accept what you say, and you are the expert and I am not, but I want to try to pin down exactly what the relationship is between deforestation and the drought because I attempted to find out about this in preparation for the hearing. I heard your statement as somewhat different from what I could glean beforehand. I am not really challenging you so much as offering you the opportunity to provide—and if you want to provide additional testimony for the record on this point, I invite it. But I am genuinely curious as to what this relationship is.

Mr. LACOSTE. Mr. Chairman, my organization experienced in many years the building of small dams to keep the rainfalls. And around those small lakes, you know, the local population have horded more trees, have cultivated in the dry season and, in fact, they have recreated in those areas a microclimate after many years. If we take the example of one region in Burkina Faso when the program started in 1974-75, they built in 10 years 11 dams. One of them is keeping back 5 billion cubic metric cubes of water behind it. And the people have water the year long. There are trees that created a microclimate. In those areas they have more rain and they can produce more food now. Once the rain falls in a region, unfortunately I am not a specialist on that, but from the experience that we have, we consider in fact when we can manage the rain water and we can reforest, in fact the soil is in better condition and the people are in better condition.

Senator GORE. Your view is that this particular cause of Ethiopia's problems may be reversible with management of reforestation programs and small reservoirs and the creation of microclimates that tend to accumulate water and rainfall in areas that have had persistent drought. It is obvious that even if there was an underlying cycle going back 2,000 years, deforestation would make the cycles more severe in the consequences of the peaks of the cycle more severe.

Mr. LACOSTE. It is clear, too, that if we can provide the local farmers with land in a better condition to produce and to produce surpluses, they can spare some of the surpluses for a dry season. They can spare those surpluses for a famine period. So, the problem is the same. It is food security for the country people. And if those examples, the pictures that you see there, are the kind of pilot projects that were set up by some organizations working in Ethiopia to see if something is possible. And we started the coalition from those pilot programs in Ethiopia. We are in the second year. We are supporting a soil conservation, terracing, dikes, spring water collecting, irrigation program. The area was stricken by the drought in 1984-85. You can see the difference, now it seems to be a very fertile area. I don't know if within 10 years the Sahara will be struck again by a famine. But if the local farmers can spare enough food and another famine occurs, they will be in a position to go their own way.

Senator GORE. To ride it out.

Mr. LACOSTE. Yes.

Senator GORE. When, in this century, was the worst of the deforestation from 48 percent at the beginning—from a 48-percent forest

cover at the beginning of the century to 4 percent now? When was the bulk of that deforestation?

Mr. LACOSTE. That was probably when the transportation means were more effective. In fact, when I talked to several groups in Ethiopia to know why the people of Ethiopia have cut their forests, one of the major reasons given to me to explain the phenomenon was the fact that when transportation was better organized it was lucrative to sell wood to other neighboring countries. Sudan, Saudi Arabia are close and it became easier to sell wood to those countries.

Senator GORE. When was that?

Mr. LACOSTE. Mainly after the last world war.

Senator GORE. All right. Thank you. Forgive me for interrupting the flow of your statement. Please proceed.

Mr. LACOSTE. If you allow me, I must come to the way we set up those programs in the Canadian coalition. After the drought in 1986, we started planning with the CRDA, the Christian Relief and Development Association in Ethiopia. It is an association of 62 volunteer agencies, international agencies with an Ethiopian base. Agencies wanted to work with individuals to set up an agricultural program designed to fight deforestation and increase food production. We jointly identified the following principles to guide the implementation and realization of such programs.

The first principle is local participation. The local population should be actively involved in each program. People are not passive receivers of outside aid. They play the vital role when it concerns their material well-being. We must also take into consideration their human dignity. Projects must be elaborated with the Ethiopian people.

The second is appropriate technology. We must provide the basic equipment needed to set up a viable infrastructure and we must also provide Ethiopian farmers with the means of controlling and managing their own agricultural methods and their own work tools. Each project must be the sort of project which can be spread in other village communities or implemented by other agricultural cooperatives and associations. And the need for assistance from outside sources must not make their cost prohibitive.

The third is the need to respect physical and human environments. The current trend toward collectivization is counterproductive. I think the speaker before me just mentioned that. It is very clear that there are collective farming or agrobusiness which is counterproductive for those farmers. We must make people conscious that, to a great extent, they can control their own ecological environment and improve their agricultural productivity. Certain very specific measures are called for: reafforestation, harnessing streams, building antierosion dykes and terraces. Each family can continue as an individual entity, but local populations must contribute to the collective good of all.

It is clear that food production is a family matter, but it is also clear that basic infrastructure like water collecting and reafforesta tion, building terraces [illegible]

care services, who can oversee efforts to provide adequate drinking water supplies and who can supervise irrigation methods and the reafforestation and soil conservation.

The fifth point is concerning the importance of women's role. They are involved in all aspects of food production. Women can make a further contribution as rural health care officers or as advisers in matters relating to water decontamination, nutrition, farming and the management of income-generating projects.

We in the Canadian coalition have focused our interest on seven projects submitted by seven Canadian groups and seven groups working in Ethiopia, for a total cost slightly over $9 million. Through Partnership Africa-Canada, the Canadian Government cofunds the program. In the eastern region and in spite of the very disrupting conditions which now prevail in Ethiopia, this program started in March 1989 and is well underway. To a certain extent, the projects are viewed as model projects. Indeed, the CRDA has suggested that European groups use them as a guide to provide assistance to Ethiopian populations.

One of the reasons for that is that our financial resources are very limited. And, if we want to have an impact in an area then we should act together. Prior to those projects, a program called "Seeds of Survival" was approved by another Canadian NGO and cofinanced by Partnership Africa-Canada. So, you will find details of "Seeds of Survival" in appendix III of my prepared statement.

Of particular interest is the impact of such programs on individual regions. The strong point of such initiatives is the fact that the Canadian NGO's provide the CRDA with administrative support aimed at coordinating the efforts of all groups who are active in a particular region. And because of such coordination, local groups have formed close links, exchanging their experiences in the field and sharing their knowledge and expertise.

In closing, let me say that we strongly believe that development which involves individuals and relies on their knowledge, their initiative, and their creativity is the basis not only for the improvement of their material well-being, but the very foundations of social justice, self-confidence, and self-respect.

This guiding principle has been recognized and reasserted by the International Conference on Popular Participation in the Recovery and Development Process in Africa. The Conference has held three major international meetings. The last such international meeting took place in Arusha, Tanzania, from February 9 to 12 of this year.

In their statement at the midterm review of the U.N.-PAAERD, NGO's emphasized that "participation means the full involvement of people in all aspects of decisionmaking related to the planning of their economics and societies." It is often said that people are Africa's greatest resource. Let us then find ways to effectively harness their energy and creativity in the ongoing effort of economic and social reconstruction.

This principle may hold true everywhere in Africa. It is definitely true in Ethiopia, a country with extraordinary potential. We must help the Ethiopian population in its effort to ensure the country's food supply and ultimately, its self-sufficiency.

Thank you, Mr. Chairman.

[The prepared statement of Mr. Lacoste, together with attached photographs, follows:]

PREPARED STATEMENT OF RENÉ LACOSTE

1. THE 84-85 DROUGHT

When famine struck 28 African countries, especially Ethiopia, in 84-85, several private organizations in Canada mobilized significant financial resources to provide emergency assistance. The funding provided by these organizations through donations from the public was matched by the Canadian government which earmarked a special fund to help NGOs provide food to populations in need. Following their intervention, almost all Canadian organizatons were confronted with the need to supply another, very different type of support. In point of fact, African countries, particularly Ethiopia, were faced with the threat of a repeat disaster.

While our organizaitons are prepared to provide emergency food supplies, our main goal is long-term development. Experience has clearly demontrated that ensuring food supplies in situations other than extreme emergencies eventually and inevitably creates a dependancy and hinders local agricultural productivity.

2. THE CURRENT SITUTATION IN ETHIOPIE

Ethiopia faces famine once again. The country's northern regions are experiencing extreme drought conditions. Civil war has virtually crippled all internal communications channels. Providing assistance is in itself extremely difficult... meanwhile, four million people are suffering from life-threatening hunger.

Should non-governmental organizations take action? Are they not bound to act according to the recommendations of their respective donors and should they not concentrate on sustaining long-term programs aimed at agricultural development? Ethiopia has surprising potential. If local farmers have access to the proper training programs, certain regions of the country could well generate adequate food supplies.

3. THE CHRISTIAN RELIEF AND DEVELOPMENT ASSOCIATION (CRDA)

We have begun discussion with the CRDA (Christian Relief and Development Association) to implement courses of action which in the long run will effectively counter the ravages of cyclical droughts. The CRDA coordinates the efforts of 62 volunteer agencies active in Ethiopia. Some of these agencies are based in Ethiopia, others are international.

Urged on by the CRDA, we looked at how member-agencies could work within individual geographical regions to set up agricultural programs designed to fight desertification and increase food production. As a result, we jointly identified the following principles to guide the implementation and realization of such programs:

a) Local participation:
The local population should be actively involved in each program. Program beneficaries are not passive recipients of outside aid. They play a vital role in the sectors of activity directly related to their material well-being and their human dignity.

b) Appropriate technology:
While we must provide the basic equipment needed to set up a viable infrastructure, we must also provide Ethipian farmers with the means of controlling and managing their own agricultural methods and their own work tools. Each project must be the sort of project which can be set up in other village communities or implemented by other agricultural cooperatives and associations. And the need for assistance from outside sources must not make their cost prohibitive.

c) The need to respect physical and human environments:
The current trend towards collectivization is counter-productive. We must show rural populations that to a very great extent, they can control their own ecological environment and improve thir agricultural productivity. Certain very specific measures are called for: reafforestation, harnessing streams, building anti-erosion dykes and terraces. Each vilage can continue as an individual entity, but local populations must contribute to the collective good of all.

d) Training local workers:
Training is a crucial factor in any program aimed at rural populations. In each village, we must train individuals who can supervise basic health care services, who can oversee efforts to provide adequate drinking water supplies and who can supervise irrigation methods and reafforestation and soil conservation.

e) The role of women:
Already, women are very active in all aspects of food production. Women can make a further contribution as rural health care officers or as advisors in matters related to water decontamination, nutrition, farming, and the management of income-generating projects.

4. PLANNING

As a basic premise, it is understood that expatriate personnel should be used only when local expertise proves to be inadequate. Outside experts could be called upon for their knowledge of agronomy, forestry, hydraulics, nutrition or management.

This orientation would meet the objectives set by CRDA member-agencies already involved in long-term development programs. More spefically, Canadian organizations have decided to focus on the projects submitted by seven groups. Together, over a three-year period they require nine million dollars in Canadian funding. Through Africa-Canada Partnership*,the government of Canada co-finances those programs in the eastern region of Shoa** province. In spite of the very disrupting conditions which now prevail in Ethiopia, these programs, implemented in March of 1989, are well under way. To a certain extent, they are viewed as model projects. Indeed, the CRDA has suggested that European groups use them as a guide to providing assistance to Ethiopian populations.

Prior to those projects, a program of "Seeds of Survival" was approved by another canadian NGO (U.S.C) and co-financed by Partnership Africa-Canada. You will find in Appendix III*** more information on such an important aspect of food security in Ethiopia.

Of particular interest is the impact of such programs on individual regions. The strong point of such initiatives is the fact that Canadian NGOs provide the CRDA with administrative support aimed at coordinating the efforts of all groups who are active in a particular country. And because of such coordination, local groups have formed close links, exchanging their experiences in the field and sharing their knowledge and expertise.

* See Appendix I

** See Appendix II

*** See Appendix III

closing, let me say that we strongly believe that development which invol-
: individuals and relies on their knowlege, their initiative and their crea-
/ity is the basis not only for the improvement of their material well-being,
t the very foundations of social justice, self-confidence and self-respect.

lis guiding principle has been recognized and reasserted by the International
)nference on Popular Participation in the Recovery and Development Process in
frica. The Conference has held three major international meetings to contri-
ute to the implementation of the United Nations Program of Action for African
:conomic Recovery and Development (UN-PAAERD). The last such international
neeting took place in Arusha, Tanzania, from February 9th to 12th of this
year.

In their statement at the mid-term review of the UN-PAAERD, NGOs emphasized that "participation means the full involvement of people in all aspects of decision-making related to the planning of their economics and societies." It is often said that people are Africa's greatest resource. Let us then find ways to effectively harness their energy and creativity in the on-going effort of economic and social reconstruction.

This principle may hold true everywhere in Africa. It is definitely true in Ethiopia, a country with extraordinary potential. We must help the Ethiopian population in its effort to ensure the country's food supply and ultimately, its self-sufficency.

CANADIAN NGOs CONSORTIUM FOR ETHIOPIA

Objectives of the consortium:

1- The objective of the program is to coordinate the implementation, monitoring and evaluation of long-term development projects in Ethiopa. Coordination will occur both among Ethiopian and Canadian NGOs.

2- Responding to the comments on sustainsbility raised in the evaluation of Africa Emergency Aid, the project aims to build a coordinated recovery strategy in one region of Ethiopia and to seek maximum effectiveness from coordination (cost effectiveness, shared experience and joint monitoring & evaluation).

Objectives of the program

1- To involve the people of one region in the recovery process by increasing food production water and soil conservation in order to insure food security.

2- To strengten CRDA'S ability to act as coordinating council and deal with the Ethiopian government and the local NGOs.

Role of Partnership Africa-Canada

1- To foster coordination among Canadian NGOs that have expressed interest in supporting Ethiopian groups programs.

2- To provide financial support to NGOs committed to approve programs.

30-597 - 0 - 90 - 6

APPENDIX I

A profile of Partnership Africa-Canada

In May 1986, at a special United Nations session on recovery in Africa, the government of Canada announced the set-up of a special program called AFRICA 2000. Half of the program's 150 million funding has been awarded to a coalition of 85 Canadian organizations.

Known as Partnership Africa-Canada (PAC), the group is responsible for the administration of $75 million devoted to long-term development in African and development education Canada. While funding is allocated through a peer evaluation process, PAC is much more than a fund disburser.

PAC's mandate is to meet the needs of Canadian and African NGOs in a context of long-term development. It actively encourages on-going evaluation of new methods of development work and new avenues of partnership and cooperation between Africa and Canadian NGOs.

PAC has two basic objectives:

- to promote African development by supporting and strengthening African NGOs;
- to increase the Canadian public's understanding of and support for African development.

PAC promotes programs which differ from those supported by other funding organizations; all are based on the following principles:

- partnership between African and Canadian NGOs;
- strengthening the organizational aspects of African NGOs;
- integrating overseas activities and efforts to develop education and heighten public awareness;
- supporting education and heightening the Canadian public's awareness of the issues involved in African development;
- ensuring that women are involved in all aspects of development
- supporting network development linking NGOs and coordinating their efforts in Canada and Africa.

APPENDIX II

CANADIAN NGOs CONSORTIUM: ETHIOPIAN SUPPORT PROGRAM

1. Feed Children

Enemor Woreda:	159 000 inhabitants
Total cost of the project:	1 042 552$

2. Baptist General Conference Mission

a- Insaro and Wuchale Weredas:	50 000 inhabitants
b- Ambo Wereda:	1 258 424$

3. Canadian Physicians for Aid and Relief

Debre Libanos and Girar Jarso Weredas:	72 000 inhabitants
Total cost of the project:	590 240$

4. Concern

Damot Weyde and Damot Gale Weredas:	343 000 inhabitants
Total cost of the project:	2 303 236$

5. World Vision

a- Adama Wereda:	17 000 inhabitants
b- Omo Sheleko:	103 510 inhabitants
Total cost of the project:	2 136 618$

6. Ethiopian Evangelica Church Mekane Yesus

Degem Wereda:	56 412 inhabitants
Total cost of the project:	902 480$

7. Kale Heywet Church Development Programme

a- Omo Sheleko:	64 000 inhabitants
b- Salfe Gossore:	9 200 inhabitants
Total cost of the project:	354 989$

TOTAL COST (Phase I)	**8 588 539$**
Number of participants (beneficiaries)	**1 038 567**

APPENDIX III

Seeds of Survival Programme

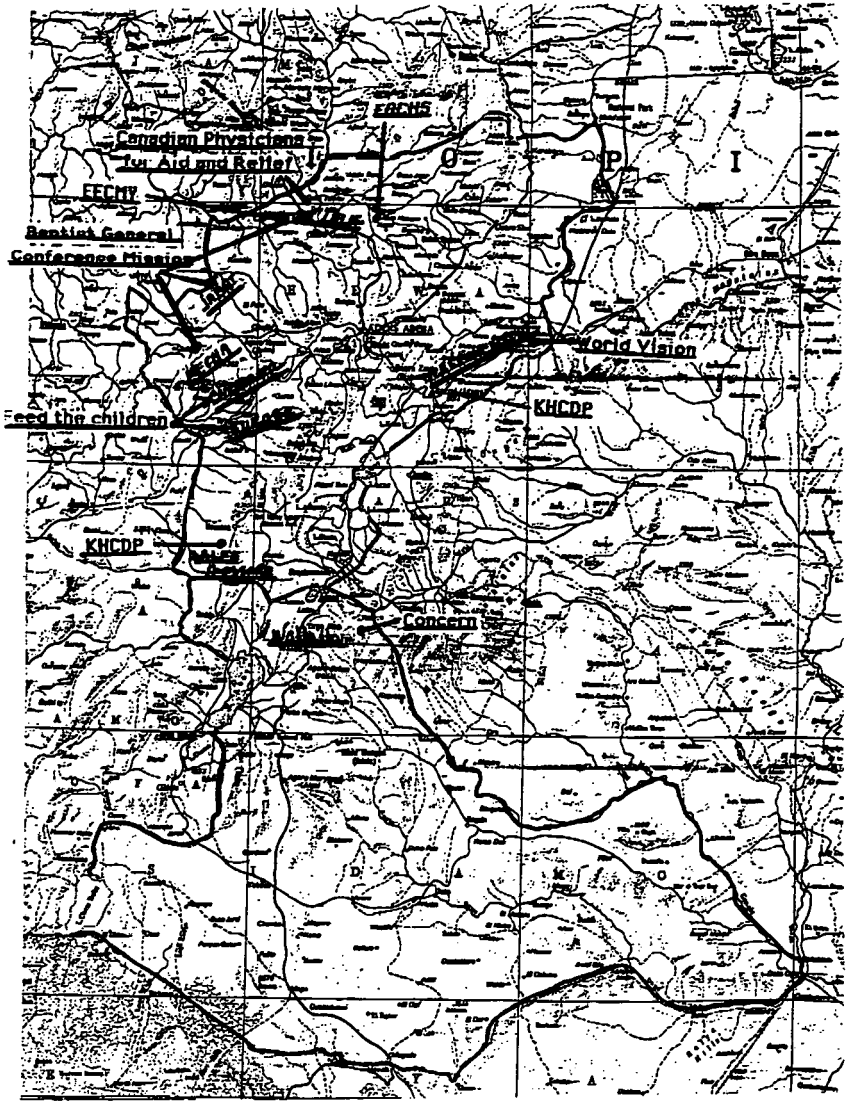
Seeds of survival is a programme to foster support for the importance to Ethiopia, to Africa and to the World of the invaluable nature of the plant genetic ressource for successful programs in food security.

The agricultural side of the programme called "landrace" utilization is being implemented in Ethiopia under an agreement between the Ministry of Agriculture, the Plant Genetic Ressources Centre and Unitarian Service Committee (USC) Canada. The primary objective is to conserve and enhance the "landraces" in Ethiopia concentrating on the five most common staple foods in the country: sorghum, teff, chick peas, fava beans and maize.

The programme is managed by an Ethiopian agronomist who works with farmers and farmer cooperatives who agree to use part of their land for planting the landraces. In the last calendar year (1989-1990), 18 areas totalling 500 hectares were planted out with landraces. Over 26,000 farm families are involved and benefiting from yield increase.

The landrace programme is low-input, low-cost agriculture within the knowledge of the farmers. The seeds have special genetic characteristics that make them stress-resistant (to drought and disease conditions) in comparison with genetically uniform seeds that are not well-suited for the harsh climate and soil conditions of Ethiopia. Through seed selection they are producing increasing yields.

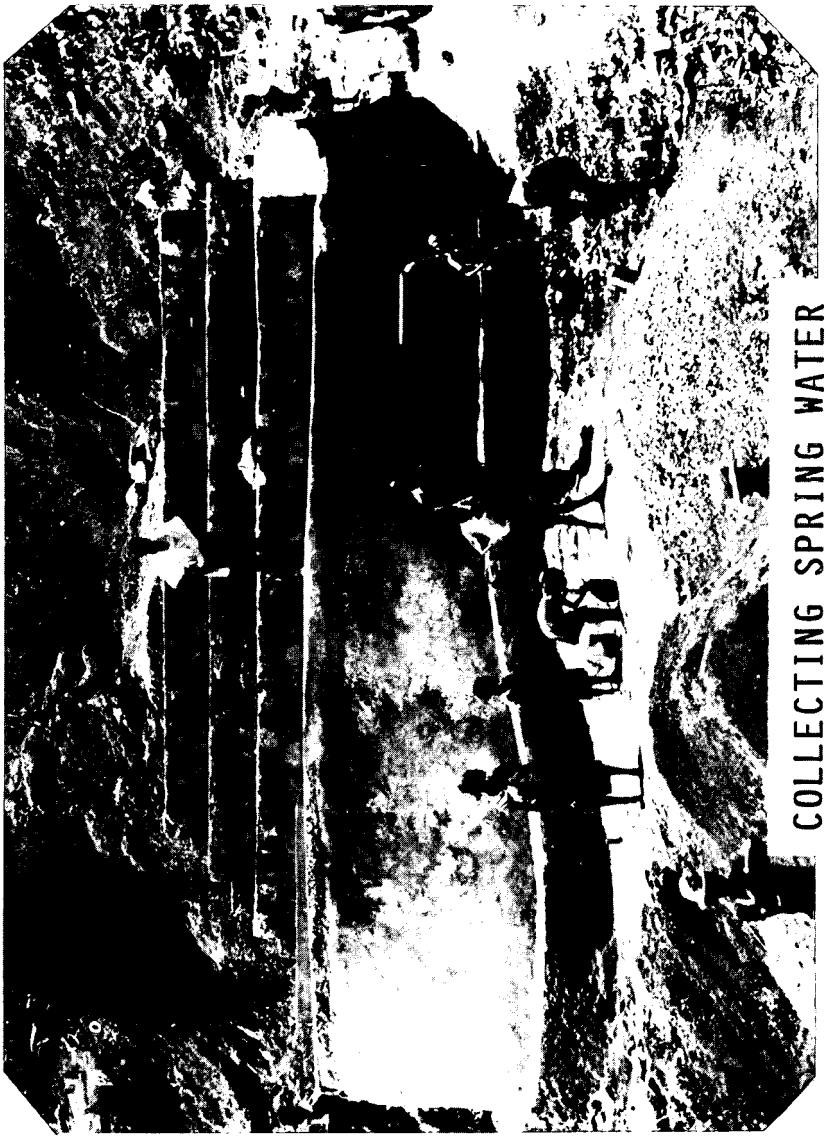
Plans for the upcoming year are to expand the cooperation with farmers and planting to 18 new sites and double the hectarage to over 1,000 hectares planted with landraces. The total cost of the programme over a three years period: 1 247 000 canadians dollars.


FACHS
Canadian Physicians
Aid and Relief
FECHY
Baptist General
Conference Mission
World Vision
KHCDP
Feed the children
KHCDP
Concern
O
P
I

ANTI-EROSION TERRACES

IRRIGATED

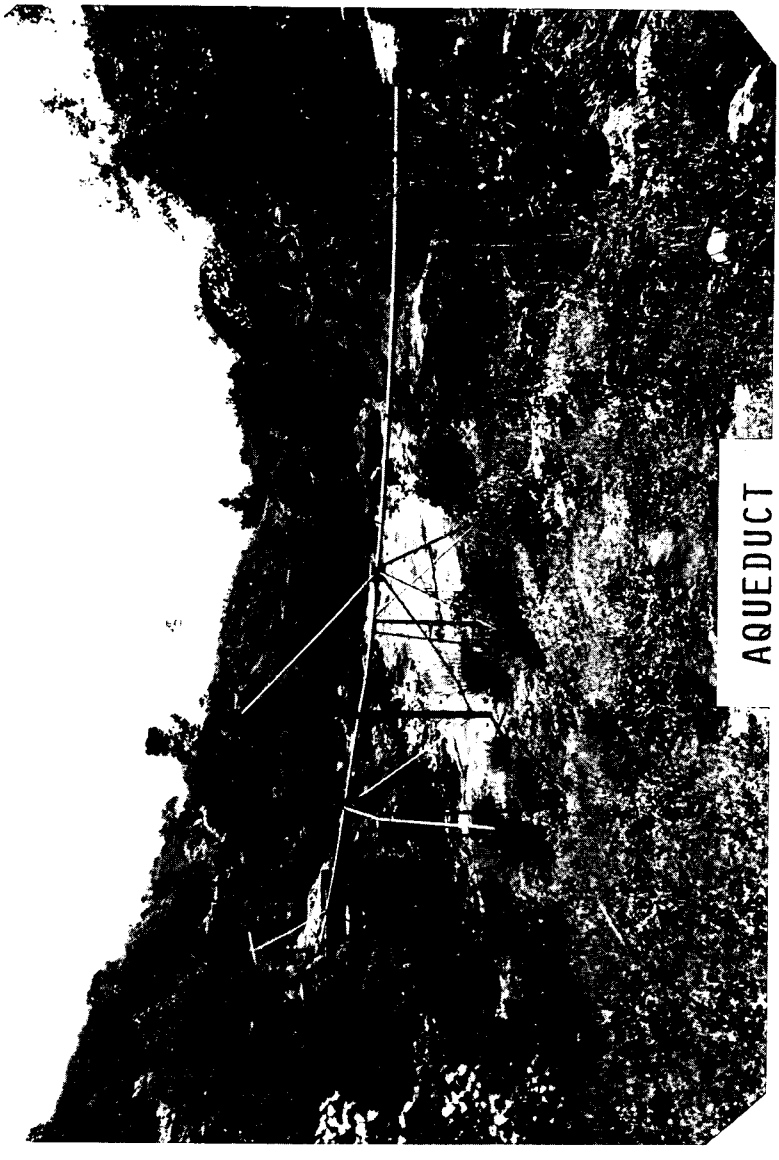
EROSION



COLLECTING SPRING WATER

IRRIGATED BANANA FIELD


REAFFORESTATION



AQUEDUCT

IRRIGATED BANANA FIELD

REAFFORESTATION

Senator GORE. Thank you very much. Let me ask some questions that come out of your testimony here. The devastating effect of desertification and drought in Ethiopia is cause for alarm. It is clear that Ethiopia not only needs aid in satisfying the immediate and cyclical demand of feeding Ethiopia's hungry, but also requires assistance in environmental rehabilitation programs. Your organization and others are engaged in essential activities for sustained agricultural development, such as agroforestry programs and soil conservation strategies. How much of your activity focuses on long-term problems like erosion as compared to satisfying immediate food needs? To what extent are the peasant farmers integrating and coordinating environmental rehabilitation practices directly with their farming practices? And how successful are the international aid agencies in promoting programs and projects with this goal in mind? Mr. Buchanan.

Mr. BUCHANAN. In the area of our development work we try to take an integrated approach. I am talking about work that goes beyond emergency relief work on the development side. We take an integrated approach which tries to take into account the needs for improved income, improved crop yields for creating surpluses of cash and food, but also which integrates those needs with the needs of the environment: environmental rehabilitation, terracing to counter soil erosion, reforestation programs, nurseries, that kind of thing. We like to build projects in a particular community with a particular peasant association that has these various aspects involved in it. So, it is not really possible to say that we do an agricultural project here and then do an environmental project over there. We try to integrate it into the life of the community itself so that the community understands the relationship between the environmental protection and rehabilitation and other needs, and the communities, of course, do understand that.

Senator GORE. Mr. Getman.

Mr. GETMAN. Mr. Chairman, in view of all the PVO's, World Vision included, it is absolutely irresponsible—even immoral—to save people in the short term in a famine situation if they are going to die 6 months or 1 year later just because they can't function day to day in their normal way of life. World Vision spends $6.6 million of its $8 million in Ethiopia for sustainable development activities. If we cannot make people self-sufficient and famine resistant, then there is no point in doing the famine relief in the first place.

Senator GORE. Thank you.

Mr. LACOSTE. Mr. Chairman, it should be an integrated program. The world community must know that the peasants should themselves control their environment. It is not the business of expatriates to make reafforestation and the antierosion program. We can support those programs, but it is their own business.

Senator GORE. By entering into the situation one changes a situation. And if by entering into it one changes it in a way that deemphasizes the awareness and the need to integrate—I mean, you are doing it so I don't—I understand what you are saying. But I don't think that one can divorce environmental management from the active assistance efforts. And you have already said that your organization recognizes that.

Mr. LACOSTE. But I must add, Mr. Chairman, that at the governmental level, it may be difficult within the present situation with the present regime, but there might be other big infrastructure work done at the governmental level rather than the local community level. But at this stage it is impossible for any private organization and maybe for any government to start huge reafforestation, water or soil conservation programs.

Senator GORE. I understand that. Mr. Getman, do you want to jump into that?

Mr. GETMAN. I was going to reinforce that point. We are busy about doing those things, even if the structures mitigate against them. And our role as expatriates is to facilitate exactly what my colleague said.

Senator GORE. Recently Sweden announced that it was withdrawing from a longstanding project in Ethiopia with the implication made that difficulty in reconciling the Ethiopian Government's requirements with the project goals had led to suspension of assistance. Are you familiar with the Swedish decision? Can you envision similar decisions by your organization if conditions exist such as the ones which they faced?

Mr. BUCHANAN. I am not familiar with the particulars of the Swedish situation, but I can well understand that in carrying out their own development agenda, the Swedish aid officials would have a certain plan according to their own priorities that they would like to put into action. This can very often come into conflict with the plans of the Ethiopian Government.

When Oxfam America tries to implement a project in Ethiopia, we sit down with the Ethiopian Government officials and present the project to them and then there is a kind of give and take. They may not want us to do certain things that we would like to do, or not want us to do them in the way that we would like to do them. This is a sort of negotiating process. And in the end we decide whether the final product is something that we want to fund, or whether the Ethiopian Government is really pushing us to do something that we feel violates our own criteria for project support. So, it is a give and take and there is a dialogue and I can understand if agencies are being pressed into something that they no longer feel they can support, they, in fact, may have to withdraw. Oxfram America is not in that kind of position right now, and I don't foresee that we will be.

Senator GORE. Mr. Getman.

Mr. GETMAN. We are not in that situation either, Mr. Chairman, because of the several hundred staff people in Ethiopia. Only one or two of them are expatriates. We are there with Ethiopians. So, we are not going to close down our projects unless we absolutely have to because of the safety of our people. We lost several people in 1984 and 1985 because we were right in the middle of the conflict. Some nurses were killed, and we closed that project down for the short term, and we have had to close some of our large-scale development projects in Wollo. But we don't intend to leave the country. Our people are not going to leave the country.

Mr. LACOSTE. We think that CRDA, whose large coalition is a strong enough organization to propose its own conditions for development, long-term development programs. So, if we continue to

support CRDA, we believe that the Government has to say yes to the proposals made to the CRDA.

Senator GORE. The key to the Swedish success in the Arsi Province of southeast at Addis Ababa was the same key that many of the witnesses here have stressed today, and that is to put the emphasis on small holders and divert resources from these huge collective failures to the initiative of the small holders who are so much more productive. That the ideological rigidity of the regime unfortunately led to the Swedish decision to pull out because they could not get the flexibility that they needed to continue and spread that particular approach.

How effective have donors been on impressing on the Ethiopian Government the need to develop a national institutional structure to meet the requirements of peasant farmers, small holders.

I take it that each of you—that the organizations represented by each of you—has attempted to make that point with thus far limited success; is that a fair summary? It is almost less success in changing the minds of the Government officials; correct?

Mr. BUCHANAN. I think it depends on who you are dealing with in the Government. The Government has many levels and many layers. Oxfam America deals with the Relief and Rehabilitation Commission and with the Ministry of Agriculture. There are many deeply committed, highly intelligent and highly informed and aware people working in those ministries who understand the development needs of Ethiopia better than any foreigner does. And they understand what is lacking in terms of government policy. They understand it very well. They understand the problems that the Government policies are creating for peasants and subsistence farmers. They understand it all too well.

The problem is that many of these policies are made at a level beyond them, the level of the central committee, the central planning organizations that are not particularly agriculturally oriented. These policies come down from the top, and they are stuck with them essentially.

Mr. GETMAN. I think it is important, Mr. Chairman, to always understand that whatever difficult situation you are in, you will find allies. And especially if the staff people are locals. They are national who have had a history in the country. The Government officials know that those people are committed to humanitarian concerns. We have found without stretching, without exaggerating, tremendous alliances in the RRC and in many other places in the Government. Not that we aren't frustrated, not that we don't have to continue to work very hard, and not that some of our projects haven't been curtailed. We are moving forward, and we feel that many of our other partner agencies are doing the same.

Mr. LACOSTE. I think the situation is different from one region to another, and it depends very much on the individual representative—recently, we developed a project in a village area, the program went well because the man was good. In the other area, about I would say 100 miles from there, the department head was just stupid. They went to the Government and had him changed. And after he was removed, the situation improved very much. Within the CRDA——

Senator GORE. Did they try that technique on the leader of the Government?

Mr. LACOSTE. In fact, we have within those groups very competent people like agriculturalists with degrees from U.S. universities. They were working within the Government before. They were fired because they didn't fit in the Government philosophy. They are hired now by private organizations. But the Government knows that those people are very intelligent and very competent.

Senator GORE. Let me ask you about the peasant associations. To what extent are the agents of the Mengistu government and to what extent will real government forces——

Mr. BUCHANAN. They were created after the revolution one would suspect as a means for control among other things. And I would expect that they do function to a certain extent as a means of control by the Central Government. But they also function in terms of organizing rural communities, organizing in terms of, as I pointed out in my testimony, being able to implement an integrated project in a wide community. I think peasant associations have their utility in terms of getting technology disseminated, in terms of distributing various inputs, in terms of having a local structure to work with, a local structure that is in touch with the farmers at the grassroots level that can identify needs and priorities that the local communities have so that development agencies can respond to those needs.

Mr. GETMAN. To link that to your previous question and your aside about Mr. Mengistu, there is nothing more revolutionary than sound developmental process and peasant associations are more concerned about the survival of their children in a basic sustainable agricultural project than they are about the greater—the transcendent political situation in most cases. So, just as has happened in southern Africa, the most powerful thing that a humanitarian agency can do is not to attempt to set aside governments but to equip the local people to do what they must do.

Senator GORE. Did you have a comment on the peasant associations and their essential character?

Mr. GETMAN. No.

Senator GORE. Mr. Lacoste.

Mr. LACOSTE. No, no, thank you.

Senator GORE. How do we go about establishing an effective program to identify appropriate technology and transfer it to the Ethiopian farmers? I listened as you described, Mr. Buchanan, several projects involving a new kind of plow, an agricultural tool from a neighboring country. Do you have any generalized comments briefly about identifying and then transferring appropriate technology?

Mr. BUCHANAN. Our approach in identifying the various technologies that we have tried to support and promote has been to do two things. First of all, talk to farmers, listen to farmers, see what their problems are, see what the constraints are to their production, see what ideas they have themselves about improving their own production. They have the experience so very often they have ideas about changing their own technology. They just simply lack the resources to make any changes and it is very difficult for them at the subsistence level to risk changes in technology that cannot be demonstrated to be successful for them.

The other thing we do is to talk to research institutions, agricultural research institutions. A number of very good ones are located in Ethiopia and have extensive knowledge of the agricultural sector. So, we put together the information that we get from these two different levels. Often there is not a lot of communication between the grassroots farmer level and the academically oriented research organizations. And so we have tried to provide a linkage role between them, and that is how we have come up with the various technologies that we are supporting.

Senator GORE. Did you want to comment, Mr. Getman?

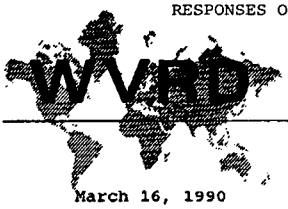
Mr. GETMAN. No, I think you were well answered by Mr. Buchanan.

Senator GORE. We may have some questions in writing. We need to move on to the final panel. I want to thank each of you again for your excellent testimony and your help in developing the committee's understanding of the problem. Thank you so much.

Mr. GETMAN. Thank you.

[The following written questions and answers were subsequently supplied for the record:]

RESPONSES OF TOM GETMAN TO WRITTEN QUESTIONS



WORLD VISION RELIEF & DEVELOPMENT INC.

220 "I" STREET, NE, SUITE 270 / WASHINGTON, DC 20002
(202) 547-3743 / FAX (202) 547-4834

March 16, 1990

The Honorable Al Gore, Jr.
Joint Economic Committee
Congress of the United States
Washington, DC 20510

Dear Senator Gore:

Thank you again for the privilege of testifying before your Committee on agricultural development in Ethiopia. Here are some additional thoughts in response to the questions you included in your letter:

1. Has the U.S. government's inability or reticence in providing assistance to Ethiopia adversely affected the agricultural development activities in Ethiopia?

There is no question we would have been able over the last 5 years to develop more famine resistent Ansokia Valley type projects if World Vision could have used government funds for the task. As it is, we are directing private and corporate gifts toward sustainable macro-agricultural development in the present reality. It is our sincere hope that very soon we can partner with USAID to expand this proven approach.

2. What changes in assistance policy....would facilitate NGO's agricultural development activities?

World Vision field and international staff feel quite strongly at this stage that the change in assistance policy must still be facilitated by a more realistic approach to the "zonal issue" by the Ethiopian government. The EEC, CEDA, USAID, and the UN and international banking agencies have not unrealisticly tended to hold off in order to influence the GOE to open up internal trade barriers. To date good production in one area has gone to waste while people have been starving in other areas. In other words, surplus production did not encourage farmers to stretch in one area while others nearby were in great need. This has been a blunt instrument used on a stubborn government...but a painful one for the NGOs as well as the people. Especially in the areas of reforestation and agricultural pattern redevelopment where people have been "villagized" resources have been lacking because of this sanctions approach. When internal changes are sufficient the external assistance policy of the multilateral and bilateral organizations will enable a quantum move forward in these areas.

30

3. To what extent has food aid prolonged the struggle? Has it exerted a depressing effect on domestic agriculture?

Food aid has helped to prolong the lives of hundreds of thousands of Ethiopian people. In our view, it has not prolonged the struggle between warring factions. A case can be made for individual situations where one side or the other received donated food for their troops, used food to lure conscripts to the army, or farmers to villages, etc....but in the overall situation this war very likely would have continued on with or without food aid.

In some cases food aid may have depressed domestic agriculture, particularly when either quantities or timing were unavoidably wrong. For example the early estimates of the severity of the 1988 famine caused donors to plan major shipments during that year, some of which did not arrive until 1989. NGOs borrowed internally for '88 programs. When the repayments arrived some of it was in excess of need and thus caused oversupply and increased the risk of dependency. The Relief and Rehabilitation Committee (RRC) has been very cognizant of these risks however and instructed NGOs to cease distribution during the '88 harvest season.

4. How do the NGOs go about determining where they will undertake development projects? How do they determine if they will cooperate with other organizations?

The RRC assigns NGOs to certain regions and does a good job of making certain NGOs do not obstruct one anothers' work. In most cases, however, the NGOs must take the initiative for both collaborative activities and actual specific areas of activity. Decisions are based on either historical presence in a region or other agendas such as a missionary group that wants a development project as an entre for church planting, etc.

Mutual self-interest is the main determinant of who cooperates with whom in a region. Though NGOs are not completely free from pettiness and politics, it is very impressive how much openess and cooperation exists among them, especially in Ethiopia. There is no question that this is in large measure because of the over-riding concern about the people in desperate need. Further, The Christian Relief and Development Association (CRDA) is a major catalyst for cooperation.

Thank you once again, Senator Gore, for the privilege of participating in this important process with you and your staff. Please be assured that there is a great amount of will among the NGO community in general and in World Vision in particular to do every thing in our power to participate in a more sustainable agricultural development effort in Ethiopia. Also, feel free to call upon us any time you feel that we might have something to contribute to the policy exercise.

Kind regards.

Sincerely,

Thomas R. Getman, Director
Government Relations

PANEL III. TOWARD A STRATEGY FOR SUSTAINABLE AGRICULTURE

Senator GORE. Our third panel is invited to come forward. The first witness will be Asmarom Legesse, professor of anthropology at Swathmore College; Pierre Antoine, acting director of Africa and the Middle East with Winrock International; and then James McCann, assistant professor of history and assistant director of the African Studies Center, Boston University.

All three of you are welcomed officially at the witness table. As with the first two panels, your prepared statements will be included in the record in full and we invite you to present a 10-minute summary of your statements.

Professor Legesse, welcome and please proceed.

STATEMENT OF ASMAROM LEGESSE, PROFESSOR OF ANTHROPOLOGY, SWATHMORE COLLEGE

Mr. LEGESSE. Thank you, Mr. Chairman. I would like to thank you for asking me to participate in these deliberations. I think that they are very important. Unfortunately, I did not have enough time to prepare as full of a document as I wished, and I will add a few comments beyond the prepared statement in my oral presentation which I would like to incorporate into the final version of the document.

Senator GORE. Surely.

Mr. LEGESSE. My field is human ecology. I have been conducting research in southern Ethiopia and northern Kenya and more recently in the northernmost part of Ethiopia, the areas that are under the control of the liberation front. My research extends from 1976 to 1985, and it concerns specifically the ecological degradation with the long-term effect of drought and famine on human communities, and with the kinds of strategies that might be useful in rehabilitating these populations.

I would say that what I have learned in Kenya contrasts so sharply with Ethiopia. Kenya perhaps offers a great deal more in terms of the future, in terms of what is possible in the area of ecological management than perhaps any other country in Africa. The Kenyans are highly sophisticated in the area of ecological education. They have monitoring programs that have been in force for more than 10 years. An ecological unit has been doing aerial surveys every year. And on that basis they can identify the areas that are in danger of desertification, can control both livestock and wildlife populations as well as regulate, to the extent that that is possible for human populations.

And so when we look into the future I think Kenya has a great deal to offer. Within Kenya there has been research teams with whom I have been collaborating, a research team, a UNESCO team called IPAL, Integrated Project on Arid Lands which has conducted a great deal of research on the issue of desertification. For example, desertification is not a demonstrable issue. There is no long-term record that can show definitively where and to what extent desertification is taking place. When UNESCO did extensive experimental studies to show if the level, the stocking densities present among the pastoral populations in Africa would ever produce desertification, their experiments failed. Yes, UNESCO has not publi-

cized this because their mandate was to find desertification and stop it. And in any case, this was presented in a scientific conference in which I was a participant. And so, the reason for desertification is not population density of the indigenous populations in Africa. The reason rather is the disruption of traditional self-regulating populations by the modernization processes. So, when we find desertification it occurs only in those areas that have had modern resource development, and urbanization of an uncontrolled character and so on. So, the blame really is not on the indigenous populations of Africa, but rather with the kinds of poorly planned modernization programs that have been in force.

Looking into the future, what kinds of procedures might be useful? UNESCO has done fairly extensive studies in northern Kenya showing that there are indigenous desert plants in the semidesert that can be used commercially, and that can be exploited by the indigenous population without asking them to change their way of life in any fundamental sense. That is one area.

The second area which I would like to mention is domestication of wild life. There is experimental evidence in Kenya showing that the oryx can be domesticated. The oryx is more productive than any of the domestic species of livestock that are now available. They are more drought resistant and more disease resistant. There is also a ranch in Texas which is an oryx ranch and apparently is also quite successful. Oryx are imported from Africa.

The third area is in the area of water resource development. Water resource development has been quite disastrous in the semiarid regions in Africa, because the type of water resource development that has been introduced is large scale, limited regionally and tends to draw livestock and human population into those areas where we find perimeters of desertification starting at the watering point and expanding outward. My recommendation to the Government of Kenya is that we start a different kind of water resource development in which we use small sources of water, usually by creating dams in dry riverbeds that can collect water. We can use technology that can be mastered readily by the population. And it has been tried in Kenya. And so what you would have is small quantities of water trapped all over the semiarid desert. Instead of concentrating the population, it maintains a balance between human, livestock and populations and the natural resources.

Deforestation has had devastating effects in Ethiopia. There is no question about that. The extent of the deforestation is subject to debate. At the turn of the century when Addis Ababa was established, the emperor of Ethiopia almost abandoned the city because a few years after the settlement all of the vegetation around Addis Ababa was wiped out, and he was ready to move his capital to another area. It was saved only because an adviser of his by the name of Alfred Ilg, a Swiss adviser, told him about a fascinating tree called the eucalyptus which grows in Australia and that if he imported it he might be able to save his capital, which he did. And Addis Ababa is now entirely covered with eucalyptus. So, there has been a type of ecological recklessness in Ethiopia which goes back centuries. And there is no evidence of serious concern with ecological matters today.

Now, with regard to deforestation, I would like to add a few comments to what was said earlier as to what happens to climate——

Senator GORE. I welcome those. I just want to ask you if you agree with these figures, that roughly 48 percent was forest at the beginning of the century, but by 1940 at the beginning of World War II, still 40 percent of the land area was forested, and it is now down to 4 percent?

Mr. LEGESSE. I have seen those figures. I have not seen very strong documentation to support them. We do know that the degree of deforestation has been extensive. But one of the things that happens when deforestation occurs is that the effect is not necessarily on rainfall, but the effect is on the mist capturing capacity of the forests. I have made long observations on the forests in northern Kenya and how much precipitation occurs without rainfall because the forests are able to capture mist and precipitate it. Because of that fact, there is a great deal of moisture accumulation. The water is actually trapped in the forest floor and then flows in the underground aquifers to the surrounding territories. And that is called "occult precipitation" by ecologists but it is not taken very seriously into consideration when people are trying to understand how forests help to maintain underground water resources and to recharge underground water supplies.

I could go on with the ecological comment but I would like to stop here and turn to another aspect of my presentation; namely, my concern with the fact that there are now two Ethiopias, and I think that this is something that we have to come to terms with. There are two Ethiopias: one is under government control and the other under the control of the liberation fronts. Tigrai Province is totally under the control of the TPLF and most of Eritrea is under the control of the EPLF. And these movements have their own relief organizations that are well established and well known to western NGO's, including the ones that are present here today. They have their own relief organizations which have effectively conducted famine relief programs through cross-border operations from the Sudan into Eritrea and into Tigrai. If the port of Massawa falls into the hands of the EPLF, which it has done, that will stop one type of relief operation. But there is another type of operation which will go on regardless of what happens to the ports.

There is also another sense in which I think it is worth looking at the type of development programs that are occurring in those territories. Unlike the Government of Ethiopia which has used essentially a top/down method of development of the elite telling the peasants how to go about helping themselves, the areas under discussion under the TPLF and EPLF have attempted instead to develop from the grassroots, to introduce the kind of technology that can only be controlled and fully controlled by the local population, to introduce methods of agricultural development that is desert adapted and can be conducted on a small scale. In a way the type of development that is advocated by the African Development Foundation and by Oxfam America is precisely the kind of development that has been espoused by the relief organizations in these two territories, and very effectively.

And so, in looking to the future, I think that the days of the present regime of Ethiopia are numbered. We have our own variety

of Ceausescu who will go the way of other dictators. So, clearly, a contemplation of the future has to incorporate within it the areas controlled by the liberational fronts and the Ethiopia that is still under the control of the Government.

Thank you.

Senator GORE. Thank you very much.

[The prepared statement of Mr. Legesse follows:]

PREPARED STATEMENT OF ASMAROM LEGESSE

SELF-SUSTAINING DEVELOPMENT AND AFRICAN PASTORALISTS

Theme

The principal object of this essay is to examine the condition of African livestock breeders in Ethiopia and other parts of Africa, and how the developments of the last 25 years have affected their productive activities. The more specific focus is to assess the degree to which the development strategies yield a self sustaining system of agricultural production and to contrast these with strategies that have produced famine and ecological degradation.

The 1960's, the Decade of Independence

It is one of the great ironies in history that the decade of African independence was also one of the wettest periods in living memory. As a result many of the newly independent nations eagerly expanded rain-fed agriculture into the marginal semi-arid zone which was formerly used exclusively for livestock breeding. Most of these development efforts were ill fated because when the rainfall pattern entered the next, seemingly more normal, phase in which periods of adequate rainfall alternated with periods of drought the projects had to be abandoned. In the late 1960's when I was conducting the first phase of my research in Southern Ethiopia I found the area strewn with abandoned and rusting tractors, grim reminders of that early attempt at "modern" agricultural development.

Again and again African governments have made the mistake of assuming that the pastoral zone in Africa is severely underutilized and they built their modern livestock- breeding and farming programs on that assumption. By contrast, the nomads have adapted not to short term periods abundant rainfall but to the long-term cycle of wet and dry years. Agricultural development must take that climatic reality into consideration if it is to become an enduring economic activity.

Water Resource Development

In this same post-independence period, many of the pastoral areas of Africa also began programs of water resource development for the herders which had unexpected consequences. It was assumed that water is a critical resource in the semi-arid pastoral areas and that increasing the supply of water for herders was an important development impetus. It was thought that new sources of water would open up pastures that were underutilized because the pastures were too far from the existing sources of water. Much of the pastoral region of Africa is now dotted with boreholes often equipped with pumps that give the pastoralist access to much greater quantities of water than

The evidence that has been gathered in the past 25 to 30 years suggests that this type of water resource development is one of the major reasons for desertification. The boreholes attract large populations of livestock into smaller and smaller rangelands with the unfortunate consequence that the vegetation cover around the new sources of water are destroyed. There is, in other words an expanding perimeter of desertification around these new

This problem has been observed again and again throughout the Sahelian zone of West Africa and throughout the Horn of Africa. Research conducted by this writer in Southern Ethiopia and Northern Kenya suggests that there are some important steps that can be taken to limit the ecological crises resulting from this type of water resource development and to introduce new types of water resources that can be integrated with ecologically sound range management practices. Before discussing these methods, however, I would like to discuss an episode in the development of range management in Southern Ethiopia which reveals some of the underlying sociological problems.

Water Resource Development: USAID Pans in Southern Ethiopia

In the early 1970's USAID was involved in such a water resource development in Borana, the richest livestock breeding area in Southern Ethiopia. After conducting a superficial hydrological survey of the region the project managers brought in heavy earth moving equipment and excavated huge water catchment areas that would trap the run off and create small artificial lakes or pans throughout the pastoral areas of Borana. These pans were located some distance away from the perennial sources of water which were under the control of the herders. As a result, it was believed that the project would open up huge rangelands that were otherwise unused. When the excavation was completed and the pans began to quickly fill up, the herders were told that they could now begin to use the new sources of water. To the surprise of the project managers and the Ministry of Agriculture, the herders refused to make any use of them and continued to use their traditional wells. At that point USAID asked me to go into the region and investigate the reasons for this problem. I did and the results were highly instructive. The Borana pastoralists explained that their rejection of

the pans had nothing to do with cattle or with pastures or with the quality of the water in the pans. They thought the pans were quite useful. They added, however, that the traditional wells were their principal instrument of social control, that men who violated the laws of the land were punished by being excluded from the entire complex of wells in their territory. Each traditional well has an officer called Abba Hirrega or the "Father of the watering Cycle." When an offender has been found guilty the ruling council sends out messages to all the well officers in the land telling them about the offender, his identity, his lineage, and the brand on his cattle and instruct them to deny the offender access to the wells. They said that this is tantamount to banishment: sooner or later the offender has to return to the ruling council, pay his dues and return to his community. Whether or not the pastoralists do in fact use the wells in this manner is immaterial. They believe they have that power as did the population as a whole. For this reason, the rejected the new pans because they believed that the new sources of water introduced by the government and controlled by district officials would have the effect of undermining their political order.

The solution they proposed was that the new pans should be handed over to them so that they could integrate these new sources of water into the social and ecological system on which their herding activities were based. In exchange they offered to fully fund the maintainance of the pans. It took years of bargaining for the government to work out a power sharing arrangement in which the district government would control the new sources of water and the herders would have a small say in the distribution of that water. In retrospect it seems that this crisis would have never happened if the project designers had consulted the population for whose benefit the project was designed and if government had conceived of the venture not as a gift but as a collaborative enterprise between national institutions and local communities. (Legesse, 1990)

Irrigation: the "Final Solution"

On the face of it one might assume that large scale irrigation would the solution that would elevate African farming and livestock breeding systems to a new and highly productive plane. Africa, after all, has some of the greatest rivers in the world and these rivers go through vast fertile semi arid zones which, if irrigated would produce enough food to feed Africa and yield abundant surpluses. The Blue Nile, for instance, goes through such areas in Southern Sudan and in a long rim of lowlands in Western Ethiopia adjoining the Sudan. Similarly, the Awash river in northeastern Ethiopia goes through the Danakil desert, an area that was used exclusively by Afar pastoral nomads until the 1960's. These areas are sufficiently flat to permit gravitational irrigation, a type of irrigation that requires far less investment on

Sudan has a famous irrigation scheme developed during the colonial period. It is called the Ghezira scheme and it produces cotton for export. It is one of the principal foreign exchange earners in the country. (Barnett, 1975) Similarly, Ethiopia began an irrigation scheme in the Danakil lowlands in the late 1960's which was also devoted to growing cotton for export. It was named the "Awash Valley Authority" (AVA) and was supposedly modelled on the Tennessee Valley authority (TVA), in the United States. When it was still

functioning in the early 1970's AVA was a very successful state farm. However its impact on the indigenous Afar population was very destructive. The project took away the best pastures of the Afar nomads and made no attempt at all to integrate the dislocated populations into the project as laborers or as beneficiaries of the development program. It was established that some 5000 Afar families were rendered destitute by this project. At that time, the World Bank, which funded the project, had qualms of conscience and pressured the Government of Ethiopia to settle this destitute population on the irrigation scheme. In 1973, I joined a team of experts to evaluate the Awash Valley Settlement Scheme and to establish whether or not the AVA has met its obligation to the indigenous population and, should, on that basis, be given a second World Bank loan. We found that in seven years of operation, AVA had settled only 215 families out of the 5000 originally targeted for assistance. (Legesse, 1977)

In this instance, and in many other such instances, it is clear that Agricultural development has been turned on its head: instead of elevating the standard of living of the indigenous population it has become an effective method of manufacturing poverty among populations who were, for centuries, perfectly able to feed themselves using simple, age-old methods of subsistence herding.

So long as agricultural development is a top-down phenomenon designed and executed by the African elite, in collaboration with their foreign advisors, but without consultation with the indigenous peasant population it will continue to to be a retrograde system of "development" from subsistence to poverty, a system that marginalizes the traditional livestock breeders and makes them more vulnerable to drought and famine than they were before the modern interventions. (Horowitz and Little, 1987: 61-62)

Capitalist Agriculture and Its Value For African Pastoralists

Agriculture is not merely a technical application of scientific knowledge to the problems of food production. The political and economic environment in which such development occurs plays a critical role in determining the success or failure of the enterprise.

Today, more than any other time in the post-war years, capitalism has become triumphant and the communist world is hastily rethinking its economic philosophy because the centrally planned economy of the Communist state has proved to be a dismal failure. Stripped of the complex ideological aura that surrounds the two systems the difference lies in the fact capitalism has evolved a thousand ways of rewarding risk taking, creativity, initiative, and achievement. In the name of the most glorious values, communism has also devised a great many ways of punishing the achiever and rewarding the indolent. It seems to me self evident that only one of these systems is destined to prevail. Given this critical difference it is inevitable that capitalism will continue to expand at the expense of socio-economic systems that lack that particular dynamic.

It is important to note, however, that the capitalism that is introduced in Africa is not the same as the socio-economic system that we are familiar with in the modern West. Capitalism as we know it is constrained by laws developed over a period of centuries. In particular labor laws and environmental legislation are the most relevant factors and these are still evolving. The complex regulatory institutions that have developed in the West have no significant parallels in Africa. It is worth recalling that at the beginning of our century Capitalism was as dynamic as is was destructive. We need mention only the devastation of rural populations in Appalachia between 1880 and 1930 as the lumber and coal industries were established and many mountain communities were horribly dislocated. In the scarmble for these coveted resources the mountaineers were deprived of their most basic means of subsistence. (Eller, 1982) Appalachian poverty was a manufactured poverty. The type of capitalism that is now being introduced in Africa is more like the coal and lumber industries of turn-of-the-century Appalachia than it is like the capitalism that we are familiar with today.

We can go on manufacturing poverty in the name of development and blame the failures on the victims, or we can transform the character of development so that the African peasants become prime agents in their own development, full participants in the decision making process, primary beneficiaries in agricultural innovation. The choice is ours.

ADF and the Grassroots: Participatory Democracy , a necessary condition for self-sustaining development

The development projects among African herders funded by the African Development Foundation have demonstrated the viability of a development philosophy based on the devolution of power to the herders and their communities. To a degree rarely seen before in African development, ADF has permitted the herders to become active partners in the design and execution of their own development projects. ADF's philosophy is that the demonstrated initiative and creative potential of African communities is the starting point for development and the role of the funding agency is to encourage and make the necessary expertise and resources available to communities who show such initiative. From its inception an ADF project permits a high degree of empowerment of the beneficiaries. Such empowerment releases a great democratic force that ultimately determines whether or not the project becomes a self-sustaining enterprise.

ADF recently brought the herders themselves together in Tanzania to take part in an extraordinary conference, the first of its kind. The herders came from Senegal, Niger, Mali, Somalia and Tanzania. In that meeting the Tuareg and Fulani of West Africa and the Somali and Maasai of East Africa spent a week together engaged in the most intense discussion about the adaptive and development strategies that each has devised in consultation with experts from ADF and with African consultants and institutions of higher learning. Perhaps for the first time we saw herders learning from other herders about strategies that work and strategies that do not. They learned about the many commercially valuable resources that are present in their respective environments, how they went about integrating the exploitation of

these resources into their pastoral economy, and how they went about integrating their economy into the wider national markets. The story of the African Development Foundation, when it is fully told, will teach us much about the democratization of the development process and the grassroots power that it releases in the service of some of the most destitute peoples in the drought-affected regions of the Sahel and the Horn of Africa.

Part of the conference in Tanzania was also devoted to letting government officials, development specialists, and international aid organizations to sit in on the meeting and listen to what the nomads had to say, *to each other*, about their experiences with development. This is a reversal of the normal roles. If the beneficiaries of development are ever allowed to take part in international conferences they are there to learn, not to teach. In the grass roots environment which ADF has created for African herders there is so much dynamic participation, so many ingenious ideas generated by the nomads themselves that it begins to look like a new and more hopeful chapter in the history of African agricultural development. Of course ADF funds primarily small-scale development projects and, as a result, their impact is not going to show up on the national GDP records. There is however nothing to prevent ADF from replicating its experiments a thousand times throughout the semi arid region of Africa and from extending its salutary influence far beyond its modest beginnings. As models of small scale agricultural development with a remarkably high level of grass roots participation the ADF experiments are unmatched in the African arid zone and can be compared only with similar experiments conducted by OXFAM America. This method of agricultural development is much more likely to be self-sustaining because the beneficiaries of development have acquired the knowledge, the skills, and the decision-making power that would allow the projects to continue to function long after the heavy hand of international expertise has departed.

Squatters and Refugees: Dependence or Self Reliance?

The rise of peri-urban squatter settlements during the era of droughts has created a major economic and social problem which should teach us important lessons about famine and its far reaching consequences. Between 1973 and 1985 very large pastoral populations were dislocated and because of the manner that famine relief assistance was distributed in camps the distribution centers became population magnets that attracted the most destitute families. The sad fact about these squatter populations is that they become a permanent, unproductive, and demoralized underclass. One such community which I observed for several years in Northern Kenya reveals that when the most destitute are gathered in the same place it is extremely difficult for them to develop a sense of community even when they become economically self sufficient. Economic development alone is not enough to make a community a self sustaining entity. Comparative analyses of such communities reveal that there are great differences between them. The settlements that evolved spontaneously and formed clusters of cooperating families proved to be the most viable whereas those that were strung out in geometric arrays in planned settment schemes and were housed in prefabricated houses furnished by the donors proved to be less a able to develop a sense of community. (Legesse, 1990)

Furthermore, it seems that the communities that contain both poor and better endowed families, as in the spontaneoud squatter settlements, are much more likely to succeed than communities that are exclusively made up of the poorest families. The idea of bringing together the poorest families in settlements schemes and trying to thus create a community has repeatedly produced disastrous results. These communities are sometimes economically successful but they are, nonetheless, sociological disaster areas. (Legesse , 1989, Legesse 1990)

The bond of dependency that develops during the period of famine relief distribution is another factor that can permanently cripple a community. Evidence gathered in Eritrea, northern Ethiopia in recent years suggests that such dependence need not be a necessary feature of famine relief programs.

In the areas that are controlled by the Eritrean Peoples Liberation Front, there are some 470,000 peasants who have been dislocated from their habitat by the combined effect of crop failures and war. Few of these internal refugees live in famine relief camps for any length of time. The Eritrean Relief Association has had a long history of self reliance that has permeated all aspects of life in the liberated areas. Upon arrival, the internal refugee who comes under the care of ERA is given a hoe and a shovel. He is encouraged to begin rebuilding his life and his liveslihood as soon as he has the strength to do so. The refugees never live in barracks built for them by the famine relief organization as is often the case elsewhere if Africa. Instead they build their own shelter almost as soon as they arrive. They build terraces in the most barren areas of northern Eritrea, in the Sahel province, scrape out what little soil they can get between the rocks, lay down a thin layer of soil on the terraces and begin to cultivate vegetable gardens. At other times they dig waterholes in the dry river basins with the aid of ERA engineers and use the water to cultivate small fields.

The most remarkable type of cultivation in the semi arid zone that has been initiated by ERA engineers is worth mentioning in some detail. ERA has developed a way of cultivating very arid areas that were formerly thought to be totally unsuited for rain-fed cultivation. They do this by completely levelling the fields, establishing the fields at different heights and separating the fields with embankments. When and if it rains, the water is canalized from the adjoining hills onto the fields. The water is allowed to stand on each field long enough to deposit some silt. It is then transmitted with sluices to successively lower fields. The character of the soil is such that it does not crack extensively when the surface dries up and is therefore not exposed to high levels of evaporation. The water is trapped under a layer of silt and by manually punching holes in the dried silt corn and sorghum seeds are planted manually. Thus, with the most minimal amount of rainfall, ERA has succeeded in getting abundant harvests in some of the most barren areas of Eritrea. The method is laborious but it has produced food in an area that had never been cultivated before.

The remarkable fact is that the entire system of famine relief, rehabilitation, and development is being carried out by an indigenous humanitarian organization, ERA, with the aid of some 120 NGO's abroad with which it maintains contact. (Patreman, 1988) It is run by an army of unpaid volunteers and has one of the lowest overheads on record among relief organizations. It is an association that has a deep and abiding faith in appropriate technology and in the need to completely master whatever technology it adopts. There are important lessons that the Third World can learn from this most unusual experiment in self reliance.

Adaptive Strategies, Indigenous Knowledge and Local Resources

Research on the human ecology of African herders reveals that the nomad has extremely complex knowledge of the semi-desert environment and of the many species of trees, shrubs and grasses on which humans and livestock subsist. Often, development specialists do not make direct use of this body of knowledge in designing their programs. As a result they fail to make use of the most valuable resources that are locally available and often introduce cultigens and materials that are not supported by locals skills, knowledge, resources, and habitats. The Boran pastoralists of Southern Ethiopia and Northern Kenya have detailed knowledge of some 400 species of plants that grow in their region. These are species that have high nutrient content, are especially palatable to their livestock, have madicinal value or many other practical uses. They also have extensive knowledge of extremely drought-resistant species of plants that can be used as emergency foods when protracted droughts weaken their livestock. Sometimes these are roots which they can dig from among the lava rocks, load on their camels, and transport to their homes to feed their small stock and their families. In periods of extreme drought, knowledge of this vegetation can spell the difference between life and death. (Legesse, 1989; Legesse, 1990)

The Kenya National Herbarium in Nairobi has in recent years developed a new section devoted to collecting specimens of local plants from the arid zone and studying all the vegetation which the pastoralists know about. Thus, the age-old wisdom of African herders is being converted into scientific knowledge which can be employed in designing modern development programs. The research reveals that the semi-arid zone has many desert-adapted cultigens which have commercial value and can be exploited by the herders themselves without necessitating a radical alteration of their way of life. In other words they do not have to be totally sedentarized in order to exploits the valuable vegetation that is present in their habitat. (Legesse, 1990)

Here then is an example of development that is built on existing knowledge, on local resources, on a collaborative relationship between the development expert and the indigenous men of learning. Such development is much more likely to have an enduring economic impact than one that is based on entirely imported resources, alien ideas, and an alien body of knowledge. Whether agricultural innovation is self sustaining or not does, in the final analysis, depend on the degree to which the innovation is rooted on the local habitat and the local culture.

Domestication of Wild Species of Antelopes

Among the many rich resources that the African semi-desert has to offer one of the most promising is the wide array of mammalian species that are highly desert adapted. Research conducted in Kenya has revealed that some of these species can be readily domesticated. There is some evidence that the Oryx may be one species that can be fully domesticated and there are ranches of Oryx that promise to be commercially viable. Because it is more resistant to disease and has a higher capacity to survive droughts than do domestic cattle, the Oryx is potentially valuable. This species is reputed to be less dependent on water than any of the East African antelopes and could, if properly domesticated, contribute greatly to the survival and prosperity of the African pastoralist. 'This is one area of research that has great promise but has not so far been fully exploited. A truly far sighted development plan in the African rangelands should incorporate a major component of experimentation with the domestication of the plains animals. (Ottichilo et al, 1981: 23; Lendell, 1977; Teer, 1975)

Ecological Research: a necessary condition for the development

IPAL, the Integrated Project on Arid Lands, which is an arm of UNESCO, and a component of the Man and the Biosphere Propgramme, has, during the past decade, conducted extensive research in the arid zone of Northern Kenya. The literature produced by this team of scientists is extensive and very impressive. It is not possible to sum up their fundings in this brief report. Mention might be made of two of the most important results of this research which are relevant to our present discussion.

A. IPAL has conducted a botanical survey of the semi desert and examined the indigenous species of trees, shrubs and grasses which might have commercial value. They have also introduced exotic species from other parts of the world in an effort to show how the desert-adapted but commercially valuable species can be used as basis for modernizing agricultural practices. IPAL's findings in this area can be extremely valuable for the future of agricultural development in the arid zone. (IPAL, Herlocker, 1979a)

B. IPAL has also attempted to gather experimental evidence on one of the most contentious issues in the ecology of the arid zone. They have attempted to use exclosures to test the degree to which high stocking densities in the pastoral zone may be the cause of desertification and ecological degradation. To the surprise of the investigators they found that there was no evidence whatsoever that the highest stocking densities that we find in the undisturbed nomadic population of the arid zone have a demonstrable effect in producing desertification or ecological degradation. These findings were reported to a group of UNESCO scientists in 1976 in a symposium in which this writer was a participant. Unfortunately, the mandate of the research team was to study and find ways of stopping desertification. Hence, the results of the exclosure experiments were not publicized. The implication of these findings

is that the principal cause of desertification is not the management practices of the pastoral populations in Kenya but rather the modern interventions that have severely disrupted those management practices. When we claim that overgrazing by African herders is the main cause of desertification we are, in short, blaming the victims.

Demographic Regulators in the Arid Zone

Research conducted by this writer in Northern Kenya has demonstrated that the African pastoralist has naturally-evolved strategies of human population control that are highly effective. The principal mechanism which they employ is the postponement of marriage and childbearing until a fairly late stage in the human life course. But they also have a dozen other strategies besides. (Legesse, 1973, 1989, 1990). Comparative research conducted by other investigators in the Sahelian zone in West Africa also suggests that the population of African herders have built-in regulators that make their growth rate much lower than that of corresponding farming communities. (Swift, 1977, pp. 465-70). Furthermore research on urbanization of herders indicates that as the herders are sedentarized their population growth rates increase. It is clear therefore that overgrazing in the arid zone of Africa is not the result of expansive character of the indigenous populations but rather the result of the destabilizing impact of modern interventions including poorly planned development, unregulated urbanization, and the introduction of inappropriate technology.

Kenya, Ethiopia and Eritrea : Contrasting Strategies

Current research in these regions reveals that the Ethiopians have failed miserably where the Kenyans have succeeded. In 1973, the first crisis of recent decades, both countries were hit by the same drought. The drought in Northern Ethiopia and Northern Kenya was equally severe. Nevertheless the Ethiopian famine was devastating, whereas the Kenyans mobilized their considerable national resources to deal with the famine and save human lives. Furthermore Kenya has a network of dirt roads that reach to the remotest provinces whereas Ethiopia has a great shortage of feeder roads outside of the principal arteries that connect provincial capitals with the nation's capital. As a result even when international relief aid was forthcoming it could not be delivered to the remoter drought-affected populations of Ethiopia. Within Ethiopia, the liberated areas of Eritrea now have a network of well maintained dirt roads similar to those of Kenya. This has greatly facilitated the distribution of famine relief assistance and the dissemination of information and development inputs. The same pattern was again repeated in the mid 1980's. The drought was severe in the same areas but the consequences of the drought for the human population were vastly different in Ethiopia and Kenya. The Marxist regime of Ethiopia failed to respond adequately to the famine as had the preceding regime of Emperor Haile Sellassie a decade earlier. (Henze, 1989: 14-15.)

The difference is not merely a matter of national resources, national wealth or infrastructure. It is a much deeper phenomenon. Ethiopia is one of the most ecologically reckless nations in Africa, Kenya is one of the most

sophisticated. This is partly due to the fact that wildlife conservation is highly developed in Kenya and, as a result, ecological awareness and education has developed to a much higher degree than any other part of the continent. By way of example one might cite the fact that KREMU, the Kenyan Rangelands Ecological Monitoring Unit, periodically conducts aerial photographic surveys of the arid zone which permits the country to determine cases of ecological degradation, and of unsustainably high livestock or wildlife population densities. This permits agricultural extension workers and game wardens to keep these populations in check so as to prevent ecological degradation. Similarly, the magnificent montane forests of Northern Kenya have been fully protected throughout the colonial era and are, to this day, quite well protected by the forestry department of the government of Kenya. By contrast, Ethiopia's ecological management strategies are woefully inadequate. During the past three decades, wildlife has been decimated and montane forests have been severely cut down. There is, therefore, an inevitable process of ecological degradation which impacts on underground aquifers, on agriculture, and on the survival capabilities of herders and farmers. (Legesse, 1990)

With very limited resources, liberated Eritrea has done a far better job than Ethiopia, in anticipating famine, soliciting assistance from European and American NGO's, creating the infrastructure necessary to distribute food and medical supplies, rehabilitating the drought-affected populations and teaching them drought-resistant methods of food production. (Firebrace and Holland, 1985) The region is also beginning a serious program of reforestation and water resource development. All this is done while the territory is exposed to constant aerial bombardment thanks to the massive military assistance that Ethiopia has received *and continues to receive* from the Soviet Union. If relief, rehabilitation, and development can be carried out so effectively under such dismal conditions, there is hope that it can be carried out also in other parts of Ethiopia when the present repressive regime has given way to a more progressive government.

Concluding Note

The simple set of conclusions that one can draw from many years of observation and research in the semi-arid zones of the Horn of Africa are

A. Water resource development in the African rangelands should be modest in scale and spread out throughout the arid zone, to avoid perimeters of desertification around abundant sources of water. The devastating effect of poorly planned water resource development on human and livestock populations should be a primary object of

B. Famine relief and rehabilitation should be done in such a way that the dislocated communities can be put on a program of self-reliant development from the moment they arrive in famine relief camps. A year of helplessness and handouts may do irreversible damage on the psychological and sociological make up of those communities.

C. If a new community must be created to accommodate the dislocated population, the design of the new community should be sociologically and ecologically sound. The community should not be made up exclusively of destitute families. Instead, a normal mix of the impoverished and the better endowed families seems to mitigate the stigma of poverty and allow the community to get back on its feet.

D. The control of human and livestock population densities is a critical factor in the arid zone. Modern regulatory practices should be built on the existing array of demographic regulators that are present in pastoral populations in Africa.

E. The beneficiaries of development should be empowered to initiate and carry out their own programs and the role of the expert should be as a resource person not as a guide, and most certainly not as a

F. Development programs should be built on existing adaptive strategies of the indigenous populations and should be devised in continuous consultation with those populations.

G. Only such appropriate technology should be transferred to these communities as can be completely mastered by locally trained workers, can be supported by local resources, and is consistent with the preservation of local habitats.

Bibliography

Cockrum, E. Lendell,
1977 *The Case for Domestic Herbivores.* University of Arizona, Unpublished MS.

Eller, Roland
1982 *Miners, Millhands and Mountaineers: Industrialization in Appaliachia,1880-1930.* University of Tennessee Press, Knoxville.

Henze, Paul
1989 *Contrasts in African Development: The Economies of Kenya and Ethiopia, 1983-1984,* Rand Corporation.

Horowitz, M and P. Little,
1987 "African Pastoralism and Poverty: some implication for drought and famine," in Glantz, Michael H. (ed.) *Drought and Hunger in Africa: Denying Famine A Future.* Cambridge University Press.

Integrated Project on Arid Lands (IPAL)

1981 ***Combatting Desertification and Rehabilitation of Degraded Production Systems in Northern Kenya,*** IPAL Technical Report no A-4. UNESCO-UNEP.

1984 ***Smallstock and Cattle Productivity, Nutrition and Disease in Northern Kenya.*** IPAL Technical Report number E-8.

1979a Vegetation of Southwestern Marsabit District, IPAL Technical Report D- 1.(Dennis Herlocker), Nairobi.

1979b ***A Report on the Status, Importance and Protection of the Montane Forests.*** IPAL Technical Report D-2a, Nairobi, (T.J. Synott)

Legesse, Asmarom

1990 ***A Pastoral Ecosystem: Field Studies of the Boran and Gabra of Northern Kenya,*** Book Manuscript,Approximate Publication Date, June 1990.

1989 "Drought, Adaptation and Development," in Rebecca Huss-Ashmore and Sol Katz, Editors, ***African Food Systems in Crisis,*** Gordon and Beach Science Publishers.

1980a "Post Feudal Society, Capitalism and Revolution," in ***Leo Frobenius Symposium,*** Deutsche UNESCO Kommission, Bonn.

1980b "Human Rights in African Political Culture," in Kenneth W. Thompson, ***The Moral Imperatives in Human Rights: a World Survey,*** University Press of America.

1977 "Flexibility and Change in a Pastoral Society," ***American Universities Field Staff.***

1976 ***Ecological Stress and Pastoralism in Africa,*** Program of African Studies, Northwestern University,

1974 ***Preliminary Research Progress Report on Urbanization in Addis Ababa,*** IDR Document Number Thirteen, Institute of Development Research, Haile Selassie I University, December, 1974

1974 ***Evaluation of the Awash Valley Settlement Programme,*** Ministry of Agriculture, Ethiopian Coauthors: N. Fadda (FAO) and R.K. Krishna (IBRD).

Legesse, Asmarom
1973 *Gada: Three Approaches to the Study of African Society*. Free Press-Macmillan, June, 1973.

Ottichilo, W.K., Kabaru, E. Mbugua F.M. and Stelfox, J.G.
1981 *The Conservation and Utilization of Wildlife in kenya as a Renewable Natural Resource*. KREMU technical report series, No 41.

Teer, James G.
1975 Commercial Uses of Game Animals on Rangelands of Texas, *Journal of Animal Science*, (1975): 1000-1008.

Senator GORE. Our second witness is Pierre Antoine, acting director of Africa and the Middle East with Winrock International.

Welcome and please proceed.

STATEMENT OF PIERRE ANTOINE, ACTING DIRECTOR, AFRICA AND THE MIDDLE EAST, WINROCK INTERNATIONAL

Mr. ANTOINE. Thank you very much. I will present a few ideas that some of my colleagues and myself put together and which are based on observations that result from actual work in Ethiopia and neighboring countries. I will agree with my colleague to the right that in the past there was a sustainable agricultural picture in Ethiopia like most African societies. The situation changed drastically, I would say, in the past 50 to 100 years due to a variety of reasons that everyone might have his own interpretation on.

I believe that the population explosion plays a major role. I won't expand too much on whether or not there is actual desertification in Ethiopia itself, although it is a fact that many forests have been cut, and as a result very often you have gigantic problems of the loss of natural resources themselves. That in itself could be called by some desertification.

We know also by experience that the average fertility of the land in most African countries, including the southern part of Ethiopia, is dropping. It is dropping possibly because of the new techniques that have been forced upon the local populations by some different societies, but also because the actual sustainable system which existed in the past has been disrupted due to the population explosion. I would say that the time for fallow has been drastically reduced, exposing the soil to a decrease of fertility, both from the physical and chemical standpoint, and also to the increasing problem of weeds.

In all of these contexts we realize that Ethiopia is an extreme—has an extremely variable climate that may cause very difficult conditions and very difficult interpretations of the situation. The few ideas that we propose here are based on an Ethiopia that would not be plagued by the present political situation and by the war.

You mentioned, Senator Gore, earlier in your comments that we wanted to prepare for the postwar era. How can we go about proposing a sustainable agricultural development strategy? I will touch on a few points that relate to this concern of yours. I think development must prove itself sustainable in four important ways. First, wherever we work in the sub-Saharan continent we have to become concerned about the maintenance of natural resources. There is no question that modern techniques using modern, heavy equipment to plow the soil, eventually causing the degradation and destruction of the soil, should not be considered as a tool for agricultural development. Cutting the forests and hilly areas where the land should be used for production of wood is not a solution in itself.

That reminds me of a figure that I read yesterday in the OTA book published by the U.S. Government in 1988. The figure stated that the Sahara desert's border is presently advancing at a rate of

10 kilometers per year, including the country of Ethiopia. I don't know how truthful those data are, but I read them.

The second type of sustainability that we must approach is the economic viability. No agricultural system can be sustained that does not provide farmers with enough income to support their families, send their children to school, and provide them with a decent life. At the national level, systems must meet the needs of individual countries for food, fiber, and export earnings.

Third, there must be a preoccupation with institutional survival. The agricultural development programs must provide their own demise by ensuring the long-term survivability of institutions and individuals. This deals with technical assistance, especially foreign technical assistance. We are involved at Winrock in a variety of projects financed by the World Bank, by the U.S. Government, and by other agencies and foundations. Very often those programs are not successful until the end. However, when the foreign assistance ends, either financially or in terms of the expatriate staff, the national governments are often unable to assume the responsibilities that they were, in theory, supposed to assume and the program collapses. I think that these types of programs should not be started in the first place, that there is arrogance on the part of the foreign technical agencies to believe that the national governments are able to take over the relief. The effort must be in cooperation with the national governments from the first stage of the design.

There is a fourth type of sustainability that I have not included in my prepared statement, and I will rectify that here. It is the social viability of the technologies that you propose. It is a fact, of course, and such a commonsense idea that I did not include it. If the local populations don't accept the technologies, of course there is no viability and you should not go into this area. So, drawing on the experience that we have gathered in other countries, in Ethiopia and other parts of sub-Saharan Africa, we see four major axes for promoting strategies in sustainable agricultural development.

The first is developing new technologies through agricultural research. I think that Ethiopia and other neighboring countries have good agricultural research institutions, but those institutions are not sufficient to meet the demands. There are excellent technologies that already exist, but they are not known to the local populations.

The linkage between agricultural research and technology transfer is generally poor. There must be a major effort to have the two working together, and to have the farmers and the recipients of the agricultural research efforts participating in the design phase. Too often, this is not the case.

I want to submit to this panel a little study that we did recently for the World Bank entitled "Agricultural Potential of Mid-Africa," a technological assessment in which we reviewed the present constraints and the successes. We feel that a lot of technology exists, but there are a few constraints that must be addressed more specifically.

One of them is the problem of soil fertility and fertilizer use. I am more and more convinced that the No. 1 problem in agricultural development in Africa, seen from a biological standpoint rather

than social and economic, is the maintenance and the degradation of soil fertility. That to me is No. 1, and I wanted to mention it.

I also want to say that many of the research institutions don't have the right preoccupations and have, in the past, not been concerned enough with the preoccupations of the farmers. I read in an OTA document, which I referred to earlier, that in Africa 80 percent of the farmers are using intercropping as the main way of cultivation, but only 20 percent of the agricultural research centers in Africa deal with this issue of intercropping. This is another example.

As I said, the second major objective is to have the research and extension for technology transfer, not only to tell the people how the technologies work, but also to listen to them and to involve them in the design stage. I think that it must be a top-down and a bottom-up approach, and that the farmers and the recipients must be involved at all stages in the process of agricultural research and extension. The major long-term goal is to train people at all levels. The main tragedy in Africa is a lack of qualified people at all of the levels. Many officials are not familiar with the subjects they have to make decisions on. There are too few technicians to guarantee a proper infrastructure and too few qualified economists, certainly in countries like Ethiopia, but there is a need for many more.

The fourth priority is to have incentives, and that was covered by my colleagues before. Without the appropriate policy, you will not be able to provide any good extension of agricultural development. And I insist on the importance of offering incentives to the farmers. The incentives can be in a variety of forms. I may disagree with some of my colleagues who are talking essentially in terms of low-sustainable agriculture. I think African farmers, when they are provided with a good incentive and are able to sell a good cash crop, will seize that opportunity and will eventually build some income. And he would then be able to incorporate the income into his farm.

And fifth and last, and I will conclude here, there must be investment in the infrastructure in food supply and market development. You can have the best technologies in hand. You can have the best knowledge on how to apply fertilizers and how to grow a cash crop. However, if you are unable to market the crop or if you are unable to get the fertilizer at the proper time, you will have a problem.

I believe that I have used my 10 minutes. I will stop here. I propose to add a few additional remarks in a prepared statement later. Thank you very much.

Senator GORE. Thank you very much.

[The prepared statement of Mr. Antoine, together with an attachment, follows:]

PREPARED STATEMENT OF PIERRE ANTOINE

In the years preceding the twentieth century, traditional cultural systems and farming practices were generally sustainable throughout most of Sub-Saharan Africa, including Ethiopia. Over the last few decades, however, population pressures on the land -- both human and livestock -- have substantially increased. As a consequence, fallow periods have decreased widely, and rangeland has become more heavily grazed.

Declining fallows have disrupted the soil fertility and nutrient equilibrium, and have exposed croplands to more serious weed problems. Overgrazing, increased demands for fuelwood, and severe drought cycles have also contributed to increasing problems of land degradation, including fertility loss, erosion, and even desertification.

Although the southern portion of Ethiopia still holds vast expanses of fertile land, it must be recognized that the potential of this land is finite. Without careful management, these fertile lands could be subjected to rapid and irreversible degradation.

As a result, the search for sustainable methods of agricultural development poses a pressing challenge for Ethiopia and much of the rest of Sub-Saharan Africa. The region will continue to suffer from recurring famine and poverty unless researchers can identify technologies that prevent resource degradation while enabling farmers to achieve decent standards of living.

Agricultural development offers the only realistic hope of escape for Ethiopia and other countries where the vast majority of the people earn their living from the land, and where city-dwellers spend the bulk of their income on food. This development must, however, prove sustainable in four important ways:

-- **Maintenance of natural resources.** A sustainable agricultural system preserves the productive resources on which it is based, guaranteeing their availability for future use. Systems cannot provide long-term productivity if, in the short term, they cause such problems as soil degradation and desertification.

-- **Economic viability.** No agricultural system can be sustained that does not provide farmers with enough income that they can support their families, send their children to school, and provide them with a decent life. At a national level, systems must meet the needs of individual countries for food, fiber, and export earnings.

-- **Institutional survival.** Agricultural development programs must provide for their own demise by ensuring the long-term survivability of institutions and individuals. This means that programs must build their own bases of financial and human resources. No program is sustainable that depends on steady infusions of foreign aid, or on expatriate managers.

-- **Social acceptability.** Technologies and development programs must reflect the social and cultural values of the populations for which they are designed, or they cannot survive. This means that local people should be involved in the creation and design of programs, and should be encouraged to voice their needs and to take responsibility for development efforts.

Experience in other parts of the world has taught us that agricultural development programs must satisfy these criteria of "sustainability" if they are to succeed. But sustainability is only a measuring-stick -- a test that must be applied to development programs. There is no separate formula, no special recipe, for sustainability. Instead, sustainable agricultural development in Ethiopia will continue to include some familiar ingredients:

Developing New Technologies through Agricultural Research:
In many cases, excellent technologies already exist to increase agricultural production. Several reputable Ethiopian agricultural research institutions can be instrumental in identifying these technologies. For example, adequate crop varieties and seeds are available; fertilizer technology is well understood; small-scale irrigation systems have been developed. New technologies are needed, however, to address long-term issues in agricultural production -- such as soil conservation and long-term fertility management. Specialized technologies are also needed to develop agricultural systems that do not destroy fragile ecosystems, such as rainforests and rangeland. Simple post-harvest and storage technologies alone could prevent substantial food losses.

Linking Research and Extension for Technology Transfer:
In many areas, the most urgent needs are for applying existing technologies to the problems of farmers and rural households. This problem has two aspects: the first is to focus agricultural research on issues of relevance to farmers. The second is to take "solutions" developed on research stations, and to convey them to farmers through extension systems. One of the challenges for the next decade is to improve the links between agricultural research and extension systems in Sub-Saharan Africa. Stronger links will encourage the flow of technologies -- including sustainable management systems -- to African farmers. Another challenge will be to improve the process of extending technologies to African women, who play a crucial role in agricultural production, but are often overlooked by traditional research and extension systems.

Training People to Carry Out Development Programs:
All agricultural development involves helping people to develop new skills and to achieve higher levels of performance. Human resource development need not only focus on advanced-degree training for scientists; it should also include education for policy makers, government officials, extension agents, farmers, business men and women, and others with a stake in the agricultural sector. As people acquire skills and visions, they can take on the task of managing their own development.

Encouraging Appropriate Policies and Incentives:
Government policies and economic incentives determine the environment in which individual farmers make management decisions. Economic distortions can lead to environmental degradation and can reward agricultural practices that are not sustainable over time. Sound policies can encourage individual farmers and private-sector firms to expand their production while protecting the natural resource base. Increased marketing opportunities can expand cash crop production and allow farmers to improve their living conditions.

Investing in Infrastructure, Input Supply, and Market Development:
Increased production levels in Ethiopia will demand increased use of inputs -- such as water, fertilizers, improved seeds, and power. Farmers cannot purchase these inputs without access to markets. Rural roads, transportation systems, and infrastructure can enhance the efficiency of markets, making it possible for farmers to sell their crops at higher prices and to purchase their supplies at lower cost. Investments in infrastructure development and input supply can reap vast benefits in agricultural development.

Learning the Lessons of the Past:
After several decades of development work, we can learn from the successes and failures of the past -- particularly in the area of developing and transferring new technologies. Projects like the Sasakawa/Global 2000 effort in Ghana have shown the power of simple technologies to increase productivity. Ethiopia's development can find valuable lessons in the experience of other countries -- both in Africa and Asia.

Developing Strategies that Look to the Future:
To ensure the sustainability of agricultural production, countries must plan for the future based on a strategic perspective. Countries must assess their resource bases, their growth trends, and their long-run comparative advantages. A sustainable agricultural sector must be built on a sustainable vision of a country's economic and political future; without such a vision, no set of technologies can safeguard resources or provide for its long-term needs.

Agricultural Potential of Mid-Africa: A Technological Assessment

November, 1989

Winrock International
Institute for Agricultural Development

Agricultural Potential of Mid-Africa: A Technological Assessment

A report presented
at a
World Bank Workshop, November 29-30, 1989

Winrock International Institute for Agricultural Development
Route 3, Petit Jean Mountain, Morrilton, AR 72110

Acknowledgments

Many people have contributed to the implementation of this study, although the authors alone are responsible for its content. We are particularly grateful to the following:

Lane Holdcroft, Winrock Senior Associate, contributed background material on policy and constraints to production. Hank Fitzhugh, Winrock Africa Division Director, wrote background material on the role of livestock in Mid-Africa.

Reviews and comments were provided by Chris Ackello-Ogutu, University of Nairobi; Jock Anderson, World Bank; John Balis, USAID/Cameroon; Shawki Barghouti, World Bank; Jacques Brossier, INRA; John Coulter, Winrock Senior Associate; and Michel Petit, World Bank.

Within the Winrock community, we benefited from the comments and technical advice of Robert Havener, Dil Athwal, Richard Harwood, Robert Hudgens, and John LaBore, as well as intellectual support from many others. We also received valuable advice from Norman Borlaug, a Winrock board member.

Outside of Winrock, we drew on the resources of a number of people through personal contacts and correspondence. Four, in particular, deserve special mention for responding to our questions with extensive written materials: J.A. Ayuk-Takem, Director, IRA, Cameroon; V. Balasubramanian, IITA/IRA NCRE Project, Cameroon; Chris Dowswell, SG2000/CIMMYT; R. Swennen, IITA plantain breeder.

Others who gave written comments and materials included: M.N. Alvarez, IITA, Malawi; W. Graf, CIAT, Rwanda; A.D.R. Ker, IDRC, Nairobi; A.F.E. Palmer, CIMMYT, Nairobi; J.L. Sarbib, World Bank; and T. Stilwell, NCRE, Cameroon.

Others contacted as part of the study include: In the United States, S. Carr, World Bank; R. Christiansen, World Bank; J. Lynam, Rockefeller Foundation (now in Kenya); M. Mudahar, World Bank; and H. Walters, World Bank. At FAO, Rome: C. Joly, Manager, Fertilizer Program; H. Braun, Chief, Fertilizer and Plant Nutrition Service; A. Sayegh, Soil Survey and Land Classification Officer; and D. A. Sims, Technical Officer, Soil Resources.

In France, B. Fournier, Chef de Travaux, Institut National Agronomique de Paris-Grignon; J. Casas, Chercheur, INRA, Montpellier; J. Lefort, Directeur, Département des Systèmes Agraires (DSA), CIRAD, Montpellier; J. M. Yung, Socioeconomist, DSA, CIRAD, Montpellier; P. M. Bosc, Assistant, DSA, CIRAD, Montpellier; and M. Tourte, Senior Associate, CIRAD, Montpellier.

In Belgium, J. Degand, Professor, UCL, Louvain-la-Neuve. In The Netherlands, G. Rocheteau, Acting Deputy Director General, ISNAR.

In Côte d'Ivoire, P. Perrault, Program Leader/Agricultural Economist, Winrock, and Professor, CIRES. In Togo, P. Vlek, Head, IDRC Center, Lome. In Nigeria, J. Eckebil, Director, International Programs, IITA. In Benin, Staff of IITA Biological Control Center, Cotonou, Benin.

In Zaire, Professor Onyembe, Président Délégué Général, INERA; Dr. Lutaladio, Scientific Director, INERA; L. Seydoux, Technical Advisor, INERA/UNDP/CIRAD; B. Bimayalo, Research Scientist, INERA; J. Franssen, Head, National Aquaculture Project, Belgian Cooperation/Ministry of Agriculture; R. Marijnissen, Head, FAO Fertilizer Program, Zaire; F. Brockman, Chief of Party, RAV/IITA Project; D. Harvey, ADO, USAID/Zaire; Dr. Bewa, Secretary General, Ministry of Rural Development; Mr. Trapman, Agriculture Officer, World Bank Office, Kinshasa.

In Burundi, L. Dominessy, ADO, USAID/Burundi; M. Moussie, Chief of Party, USAID Small Farming Systems Research Project, ISABU (U. of Arkansas); B. Delaine, Agricultural Extensionist, USAID Small Farming Systems Research Project, ISABU (Winrock); Mr. Aertssens, Agriculture Officer, Belgian Cooperation, Burundi; M. D'Haese, Head, Department of Agricultural Economics, Université du Burundi; R. Branckaert, Head, Department of Animal Science, Université du Burundi; G. Sottiaux, Soil Survey Expert, ISABU/Belgian Cooperation.

In Rwanda, L. Gahamani, Director General, ISAR; T. Musabyimana, Acting Head, Plant Science, ISAR; V. Eylands, Deputy Chief of Party, USAID Farming Systems Research Project, ISAR (U. of Illinois); J. Burleigh, Chief of Party, USAID Farming Systems Research Project, ISAR (U. of Arkansas); B. Hansen, Research Scientist, USAID Farming Systems Research Project, ISAR (U. of Arkansas); P. Crawford, ADO, USAID/Rwanda; V. Ndoreyaho, USAID/Rwanda; A. Gallez, Soil Survey and Classification Expert, MINAGRI/Belgian Cooperation; G. Lassiter, Chief of Party, USAID Agricultural Policy Project.

For the SADCC region, M. Kyomo, Director General, SACCAR

We are also indebted to the following for editing and production services at Winrock: Bettye Burt, Bonnie Clarke, Sheri Doll, Wynona Keithley, Judith Killen, Sheila Miller, and Shirley Zimmerman. Joyce Olds designed the cover and title page.

Finally, we are grateful to the World Bank and Winrock for providing financial support for this study. We would also like to thank the Rockefeller Foundation for supporting research that contributed to this study.

David Seckler
Doug Gollin
Pierre Antoine

EXECUTIVE SUMMARY

This study of the agricultural potential of Mid-Africa was undertaken as part of a World Bank effort to develop strategies for development in Sub-Saharan Africa. This study represents a first step in that process. It parallels a similar study of the Sudano-Sahelian zone, undertaken by CIRAD.

The major conclusion of this paper is that Mid-Africa is a region of enormous agricultural potential. It can indeed become the "breadbasket" of Sub-Saharan Africa. While much must be done to realize this potential, the focus here is on the role of of five lead inputs, namely (a) policy reforms, (b) genetic improvements, (c) fertilizers and other methods of increasing soil fertility, (d) irrigation and water control, and (e) transportation and marketing infrastructure. These lead inputs will be the cornerstones of future agricultural development and growth in Mid-Africa. If these lead inputs can be provided, other problems of Mid-Africa can be resolved.

Africa is also a continent characterized by agricultural stagnation. Low agricultural productivity has contributed to persistent food shortages in many countries -- a condition exacerbated by drought, war and politics. In several countries during the decade of the 1980s, food shortages have escalated into full-fledged famines. Many of the continent's problems are indeed complex, but they should not lead to despair. Much of what is said about Africa today was said about Asia only 30 years ago. Africa can, it is argued in this study, solve its food problems through appropriate development efforts.

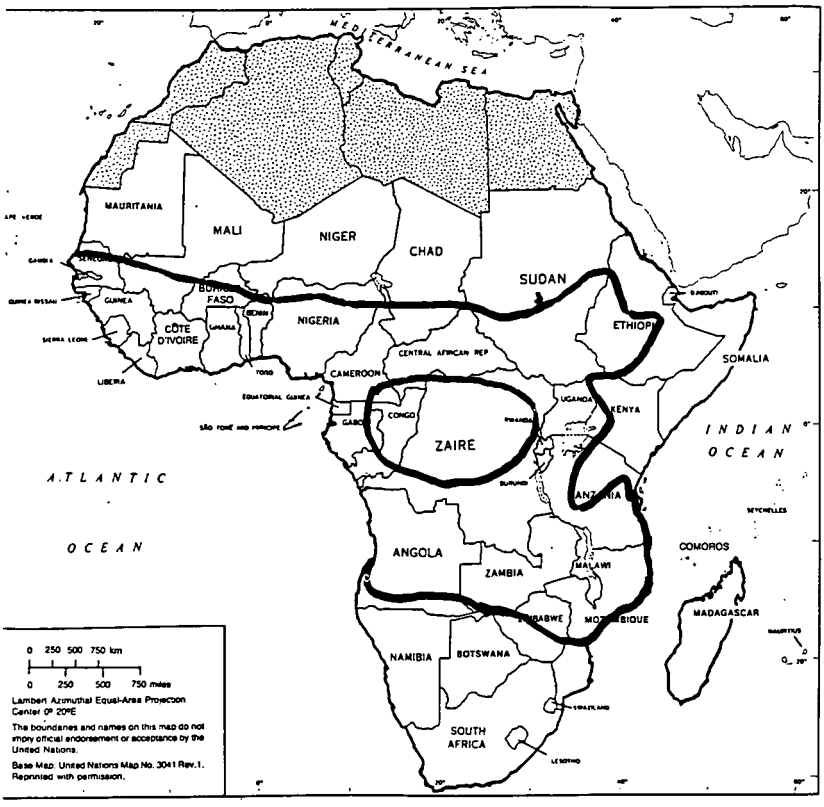
As shown in the accompanying Map 1, the Mid-Africa region has been defined as 11 countries that belong to a broadly-defined agroclimatic zone. The main feature of this zone is that rainfall is generally adequate and relatively reliable. The zone stretches in a wide band from southern Nigeria, Cameroon and Gabon across continental Africa to Kenya and Tanzania. Other countries included in the region are Congo, Central African Republic, Zaire, Uganda, Rwanda and Burundi.

Several sub-zones can be defined within the region, with the main distinction between highlands and lowlands. Parts of the 11 Mid-African countries also fall into entirely different zones -- such as northern Nigeria, for example. In addition, a number of countries that fall partly into the Mid-African agroclimatic zone, but have been omitted from this study. These include Ethiopia, Sudan, Chad, Mali, and Senegal in the north; Angola, Zambia, Zimbabwe and Malawi in the south.

Map 1


MOROCCO
TUNISIA
WESTERN SAHARA
ALGERIA
LIBYA
EGYPT
MAURITANIA
MALI
SENEGAL
GAMBIA
NIGER
CHAD
CENTRAL AFRICAN REPUBLIC
SUDAN
DJIBOUTI
BURKINA FASO
GUINEA BISSAU
NIGERIA
ETHIOPIA
GUINEA
SIERRA LEONE
LIBERIA
CAMEROON
SOMALIA
GHANA
BENIN
TOGO
KENYA
UGANDA
CÔTE D'IVOIRE
EQUATORIAL GUINEA
CONGO
ZAIRE
RWANDA
BURUNDI
GABON
ANGOLA
TANZANIA
ZAMBIA
MADAGASCAR
NAMIBIA
MALAWI
ZIMBABWE
MOZAMBIQUE
BOTSWANA
SOUTH AFRICA
SWAZILAND
LESOTHO

Map 2: Mid-African Agroclimatic Zone



The highest-potential agricultural areas of Mid-Africa are not those with the highest rainfall. The most productive areas will probably be those around the periphery of Africa's rainy central basin. This determination is particularly fortunate since the highest-rainfall zone coincides with the great tropical rainforest of central Africa. This valuable source of biological diversity can remain untouched without great detriment to the region's agriculture. In fact, development of the less humid areas outside the rainforest will relieve the mounting pressure on forest and wildlife resources.

Policies

It is widely agreed that Mid-Africa's good physical environment for agriculture must be complemented by an appropriate policy environment. With severely distorted prices or poorly controlled marketing systems, agricultural production suffers. Government investment priorities, exchange rate policies, and monetary policies all affect agriculture.

Many Mid-African countries have suffered from faulty policies during the past two decades, often to the detriment of domestic agricultural production. Policy reforms represent an important component of any strategy for development, and in the past decade numerous countries have made needed steps towards those reforms.

At the same time, however, changes in pricing and marketing policies cannot alone generate dramatic agricultural development. In many developing countries, agricultural production responds relatively little to price changes, partly because many farmers produce for their own subsistence. Changes in technology and in the resources available to farmers are essential for increased production.

Any discussion of policies for Mid-African development must recognize that many of the countries are severely constrained in their policy choices by international debts. Although these debts are not large in absolute amounts, they are extremely large in relation to the countries' GNP levels -- higher in some cases than for the most heavily indebted countries of the world.

Policies in Mid-African countries also are constrained by distorted global markets for agricultural goods, which make prices artificially low. This makes it economically difficult for Mid-African countries to provide realistic incentives to domestic farmers.

Seeds and Germplasm

One of the recurring questions concerning agricultural development within Mid-Africa has been whether suitable genetic materials currently exist to bring about substantial gains in productivity.

This study finds that, in many cases, these materials not only exist at research stations or "on the shelf," but actually are used widely "on the ground," in farmers' fields.

For many crops, currently available varieties already incorporate significant quantities of improved genetic material that have originated in international research centers and national programs. Most of Mid-Africa's open-pollinated maize varieties, for instance, include CIMMYT germplasm. Similarly, IITA cultivars of cassava have been widely adapted in Nigeria and other countries.

In the meantime, however, there is considerable potential for increasing agricultural production with existing varieties. In particular, existing varieties of maize, rice, sorghum, cassava, and other common crops show high responses to fertilizers. This suggests that African agriculture does not need to wait for decades of research before productivity gains can be realized. Research can focus on long-term needs, while substantial short-run production increases can be achieved through more readily available means.

Fertilizers and Soil Fertility

Extensive discussions with agricultural experts working in Mid-Africa underscore the urgent need for efforts to maintain and restore soil fertility throughout the region. At present, agriculture is deeply constrained by the two related problems of low soil fertility and high rates of erosion.

Especially in the highlands of Rwanda, Burundi, Zaire, Uganda and Kenya, soil erosion has increased as a result of rapid population growth. A few measures have succeeded on an experimental basis in slowing erosion; these must be pursued vigorously.

At the same time, low soil fertility must be addressed through a combination of measures. The single most important element must be the large-scale encouragement of chemical fertilizer use. At present, inorganic fertilizer use in Mid-Africa stands at extremely low levels -- around 5 kg/ha, compared with almost 50 kg/ha in most of Asia. A number of economic factors account for the low level of fertilizer application.

First, transport costs tend to make farmgate prices high for inputs and low for outputs -- thus discouraging the use of fertilizers. Second, government pricing and marketing policies often accentuate the poor price incentives faced by farmers. Third, the subsistence nature of much Mid-African agriculture implies that cash is not readily available for purchased inputs; where population densities are low, farmers will often clear additional land rather than apply fertilizers or other cash inputs. Fourth, variable rainfall levels impose a high degree of risk of cash losses on investment in fertilizers.

These economic obstacles suggest that other measures may play an important role in complementing chemical fertilizer use. Experiments indicate that organic fertilizers -- including composts, animal manures, and green manures -- have been highly effective in improving fertility. According to a number of experts, these materials have added effect of enhancing the gains from inorganic fertilizers.

All of these approaches must be pursued if Mid-Africa's agricultural production is to increase. This study argues that considerable potential exists for raising the fertility of soils in Mid-Africa through appropriate investments in research, inputs and infrastructure, to be reinforced by appropriate changes in policy structures. These investments will form an essential component of any plan for Mid-Africa's agricultural development.

Irrigation and Water Conservation

Although Mid-Africa is generally a region of adequate rainfall, the most productive areas within the region may be those on the periphery. In these areas, solar radiation tends to be higher, and disease and pest problems are fewer. Rainfall, however, is somewhat lower and more variable than in the center of the region.
Fortunately, many of these areas have soils and water supplies that are suitable for irrigation. Consequently, Mid-Africa can substantially benefit from appropriate programs of irrigation. Small-scale irrigation, in particular, can work to counter variability in rainfall, to provide water at critical times during the planting cycle, and to reduce the risk of applying other purchased inputs. Because this kind of irrigation makes possible a transition to more intensive agricultural systems, the returns to investment can be high.

In addition to full-fledged irrigation efforts, many areas in Mid-Africa can realize substantial increases in production through well-known water conservation measures. These should be promoted more widely.

Infrastructure and Transportation

Most of Mid-Africa currently suffers from infrastructure and transportation systems that are severely deficient. Poor roads tend to suffocate economic activity, by making in unprofitable for farmers to buy inputs or to sell their produce.

In many of Mid-Africa's coastal cities, it costs less to import food grains from Europe and North America than to purchase food produced in rural areas of the same countries. Not surprisingly, many Mid-African countries rely on imports -- both commercial and concessional -- for a significant proportion of their food supply. This naturally reduces the markets for domestic agricultural production -- which in turn

leads to lower production, greater import needs, and less effective demand for economic output.

Adequate infrastructure and transportation systems are a necessary precondition for agricultural development in Mid-Africa. Although previous attempts to develop both social and physical infrastructure have encountered difficulties, these are problems that must be solved if Africa is to develop. Improved infrastructure would complement investments in irrigation and fertilizer, creating an overall environment conducive to agricultural development.

Conclusions

Two fundamental concepts can form the basis of a development strategy for Mid-Africa. The first of these is the notion of "leading inputs"; the second is the idea of "growth centers."

Three of the subjects discussed above will play a central role as leading inputs in Mid-Africa's agricultural development. These are:

- fertilizers and other measures to improve soil fertility and halt soil erosion
- investment in irrigation systems, particularly those that are small in scale and privately managed, along with water conservation in rainfed agriculture
- investments in transportation, marketing and storage infrastructure

These three leading inputs have the potential to generate a strong positive synergism. Irrigation lays the base for fertilizer use, and decreases risk. Fertilizer increases yield. Infrastructure improves returns to farmers and makes investments in inputs profitable.

Aggressive investment in these three areas can encourage farmers to supply more goods to market, while providing them with the necessary technologies to increase their production.

Rather than diffusing investment widely across the region, scarce development funds can best be used to focus on specific areas; or growth centers. in this approach, specific areas would be selected as initial target zones for intensive development of irrigation, infrastructure, and soil improvement programs.

Selected first would be the easiest areas -- those with good initial endowments of resources, access to markets, reasonable infrastructure, and high irrigation potential. From these "first-order" centers, development could spread to secondary centers located at some small distance. The primary and secondary centers would be linked by transportation and communication facilities. In this way, the growth centers would

develop symbiotic trade relationships, and trade would stimulate growth in regions between the centers.

Proceeding in this fashion, a growth corridor could ultimately be developed that would cross Africa -- reaching from Nigeria in the west to Kenya in the east.

Areas in the northern part of corridor would primarily be irrigated, while those to the south would develop mainly through improvement of fertility, water conservation, and other inputs to rainfed agriculture. Such a "Mid-African Corridor" might eventually be supported by transcontinental transportation and communication systems, duty-free transit privileges, and reduced tariff barriers. Similar growth corridors might be established later in other areas of Africa.

CHAPTER 1

THE SETTING OF THE STUDY:

Agricultural Production in Sub-Saharan Africa: The Next Twenty Years

The Challenge Ahead

In an area surrounded by confusion and controversy, one of the few clear facts about agricultural development in Sub-Saharan Africa is the tremendous magnitude of the task ahead.

Over the next twenty years, the population of Sub-Saharan Africa is projected to grow at a rate of about 3.1 percent per annum. At this rate the population will increase from 494 million in 1990 to 888 million in 2010. This is the highest rate of growth of any sizeable population, outside of Sub-Saharan Africa itself, in recorded history.

Simply to match this extraordinary growth rate, agricultural production will have to grow at an unprecedented pace. A 3.1 percent growth rate would be nearly double the rate that Sub-Saharan Africa achieved in 1970-87.

In comparison, India, in the full flush of the green revolution, attained a rate of growth of agricultural production of only 2.2% over the 1965-87 period.[1]

India offers another perspective on the magnitude of the task confronting Sub-Saharan Africa in the next twenty years. The population of Sub-Saharan Africa in 2010 will be 888 million -- which is greater than the present (1990) population of India of 842 million.

Similarly, total cultivated area in Sub-Saharan Africa, now 157 million hectares, is growing at about 0.5 percent per annum. At this rate, it will reach about 176 million ha in 2010. Again, this is slightly more than India's present-day cultivated area of 169 million ha.

Thus, at current rates of growth, the number of people per ha of cultivated area in Sub-Saharan Africa will rise from 3.17 in 1990 to 5.0 in 2010, which is almost exactly the same as that of India today.

For anyone familiar with the differences between agriculture in Sub-Saharan Africa and India -- in terms of research and extension systems, transportation and marketing, policies, fertilizer consumption, adaptation of HYVs, irrigation, etc. -- the magnitude of the challenges ahead for Sub-Saharan Africa is apparent.

For example, about 5 percent of the cultivated area of Sub-Saharan Africa is irrigated, compared to about 30% in India. Sub-Saharan Africa uses less than 5 kilograms of inorganic fertilizer per hectare of cultivated area, compared to 50 kg/ha in India. The countries of Sub-Saharan Africa are not likely to provide adequate agricultural production for their populations without these and related agricultural inputs.

This comparison brings home the difficulty of achieving the 3.1 percent agricultural growth rate needed to keep pace with population growth. It is important to remember, however, that even this rate is probably insufficient for the continent's needs.

First, the current level of per capita food consumption is inadequate, at about 93% of the average recommended daily allowances for calories.

Second, this level of consumption includes food imports and food aid. In order for consumption levels to stay even in Sub-Saharan Africa, both of these would also have to increase with population. With increasing foreign exchange scarcities, the possibility of donor fatigue, and perhaps reduced agricultural surpluses in developed countries this degree of food dependency should be reduced.

Finally, Sub-Saharan Africa needs to improve its foreign exchange earnings, both to purchase needed imports and to service its foreign debt. Agriculture is one of the few sectors where Sub-Saharan Africa can capitalize on comparative advantages in international trade.

To minimally serve these needs, an additional increase in agricultural production of around 1.0 percent per annum would be required. This implies that the rate of growth of agricultural production required to make modest improvements from the present situation would be around 4.0 percent per annum.

At this rate, Sub-Saharan Africa would increase its agricultural production in 2010 to a level 2.2 times its present level. Only China, among large developing countries, has been able to achieve such a high rate of growth, with an average of 4.4% pa over the 1965-87 period. Significantly, China increased consumption of inorganic fertilizer from 41 kg/ha in 1970 to 174 kg/ha in 1987, representing an annual rate of growth of 9.5% over the period.

There can be no more eloquent testimony to the pernicious effects of excessive population growth than these statistics. Unprecedented achievements in agricultural

production will be required for Sub-Saharan Africa simply to hold the agricultural line against the avalanche of population, and even more will be required to attain modest improvements. A substantial part of the local and foreign resources employed by Sub-Saharan Africa in the future will have to be devoted to this task. While these resources would be better employed in improving the income and quality of life of the people of Sub-Saharan Africa and in protecting its unique environment, excessive growth of population leaves no serious alternative.

The task ahead is thus easy to define -- if hard to achieve. Sub-Saharan Africa must aim to achieve the 4.0 percent growth target as effectively and economically as possible, while simultaneously improving the lives of its people and protecting its environment. This is a difficult task, but we believe that with properly designed and implemented policies, programs and projects it can be done.

One of the reasons for this belief is the potential for substantial increases in cultivated area in Sub-Saharan Africa. Another reason is the presently low level of agricultural production in most of the region. Production is currently low both in relation to the resource potential of the continent and in relation to the technologies that have been tried, tested and proven in other parts of the world -- most notably, but not exclusively, in Asia.

In terms of the leading agricultural inputs, these technologies are improved seed varieties, inorganic fertilizers, and irrigation. Nowhere in the world has any country been able to sustain rapid rates of agricultural growth without high rates of utilization of these inputs in varying combinations, depending on agroclimatic conditions. Nor is there any technology in the foreseeable future that will change this fact. If, as the above data suggest, Sub-Saharan Africa in 2010 will have to look something like India today in terms of outputs per ha of cultivated land, it also will have to look something like India in terms of inputs per ha of cultivated land. This is not so much a question of choice as it is of basic physics.

Some Basic Positions

The observations presented above reflect four basic positions in this report that differ, in varying degrees, from some contemporary thinking about development in Sub-Saharan Africa and should be made explicit.

First, we believe that Sub-Saharan Africa can learn a good deal from both the successes and the failures of India, China and other developing countries. Although Sub-Saharan Africa clearly has unique characteristics and problems, it would be foolish to dismiss the experiences of development elsewhere.

Second, although we share a commitment to environmentally sustainable agricultural growth, we are wary of over-zealous and ill-informed efforts to decrease the use of inputs in African agriculture. Efforts to eliminate fertilizer use, in particular, would doom Africa to a future of agricultural shortages.

For instance, in a recent address to the Board of the World Bank Group (September 26, 1989), World Bank President Barber B. Conable called for programs to replace inorganic fertilizers with "...better methods of restoring essential nitrogen to the soil..."

No one sympathetic to the needs of Sub-Saharan Africa would recommend this as a policy for the region. Although many opportunities exist for use of organic fertilizers and manures in Africa, they cannot begin to substitute for chemical fertilizers. Agriculture in the region cannot conceivably grow at the rates needed without the use of fertilizers and other inputs.

Third, a similar problem exists with regard to "policies" and "structural adjustments". While we agree that policies do need reform in many Sub-Saharan Africa countries -- and, indeed, we consider policy reform as a leading input -- we are not certain that it is possible to specify, in the abstract, what the "right" policies are.

Much of the literature on this subject seems to suggest that all Sub-Saharan Africa needs is a free market economy with open borders, elimination of subsidies, currency devaluation and fiscal/monetary conservatism.

This philosophy has been applied to the degree possible in countries of Sub-Saharan Africa since the early 1980s. Generally speaking, this has been a period of exceptionally poor economic performance in the region, not all of which can be blamed on drought, worsening terms of trade or other factors. Correlation is not causality, but when the results vary inversely with the predictions, rational people will pause for thought.[2]

Furthermore, it is worthwhile to note that the countries of Asia that have created successful agricultural systems have followed policies that would barely receive a passing grade from most conventional policy analysts -- and of course the most successful country, China, would flunk.

In sum, we believe that "getting policies right" is not a guarantee of success in development. Rather, we believe that countries should work to avoid "getting policies wrong." Once the more obvious forms of policy abuse are sorted out, people can focus on the more fundamental -- and, unfortunately, more difficult and expensive -- problems of agricultural development in Sub-Saharan Africa.

Fourth and last, it is important to concentrate on the pace of agricultural development required in Sub-Saharan Africa, not just the magnitude of growth. It is one thing to say that agriculture production must increase by 2.2 times; but realizing that this goal must be achieved in only 20 years "focuses the mind wonderfully" (as Doctor Johnson said of contemplating the prospect of one's own hanging) on the kinds of actions that need to be taken to achieve the desired results.

These are actions that promise very large and quick effects, and that can be implemented with only modest improvements of existing capacities, within a reasonably short period of time.

Properly devised policy reforms are one such possibility -- although, as noted, the results on this front have not, in the past, been overwhelmingly encouraging. In contrast, building research capacity, vital though it is, will not show immediate returns. Rapid increase of inorganic fertilizer will produce large results within a few months, whereas improving soil quality, again a vital matter for the long-run, will yield only modest short-run gains. The task is to properly integrate these short-run and long-run actions to minimize their competitiveness and strengthen their complementarities.

The synergism between fertilizers and soil fertility provides an excellent example of the interplay between short-run and long-run approaches. If farmers can substantially increase the productivity of their land through application of inorganic fertilizers, they are strongly induced to invest in control of erosion, organic fertilizers and other methods of improving soil fertility.

Technological Assessment

A "technological assessment" in agriculture attempts to define the production frontier of an agricultural region in terms of agroclimatic conditions, natural resources, and known technologies. The central purpose of a technological assessment is to determine whether a region is basically on its production frontier -- in which case there is very little scope for short-term growth -- or whether it is substantially within its production frontier, with corresponding scope for growth under known technologies.

It is possible to conduct a technological assessment in purely physical terms, and this study utilizes two such studies conducted by the United Nations Food and Agriculture Organization and by Buringh et al.[3]

However, technological assessments must be combined with what may be called "institutional assessments" if they are to be relevant to action. Institutional assessments concentrate on the social, political and economic organization of human

behavior. The production frontier defined by institutional factors is always inside the purely physical production frontier.

Even under the best conditions, people simply do not have the time, knowledge, energy and managerial ability to do all that it is physically possible to do. Also, a group may be well within the institutional production frontier because of unresolved constraints on their activities, or unrecognized opportunities for improvement. It is the function of policy analysis, broadly defined, to integrate technological and institutional assessments into programs of action.

While the main focus of this study is technological assessment, institutional assessment and policy analysis necessarily play a significant, if less explicit, role in the discussion. This is because the ultimate objective of the study is to provide a basis for formulation of policies, programs and projects for rapid growth of agriculture in Sub-Saharan Africa and this cannot be done without at least a feel for what institutionally can and cannot be done, at what rate, over what period of time.

Having said this, we believe that technological assessment in agriculture is primary in the logical sense of being the first step. This is because agriculture is fundamentally a biochemical process of production that can only be improved by changes in biochemical processes. Changed institutions and policies are effective only in so far as they affect these biochemical processes. This fact is too often ignored in institutional assessments and policy analyses, with ineffective and even counter-productive policies as a result.

Sources of Agricultural Growth: Area and Yield

Increased crop production can arise only from increased cultivated area, or increased yield per unit of cultivated area, or both. This truism defines the two basic paths to agricultural development: the extensive path of increased cultivated area; and the intensive path of increased yields.

There is considerable debate over which of these two paths is most appropriate for Sub-Saharan Africa. We believe that this debate is somewhat trivial. Both paths must be pursued as energetically as possible if anything like a 4.0 percent annual rate of agricultural growth is to be achieved.

As shown in Table 1, cultivated area in Sub-Saharan Africa has increased at an average rate of only 0.5 percent per annum over the 1970-85 period. This means that if the 4.0 percent growth target were to be achieved, yield would have to increase at a rate of more 3.5 percent over each of the next 20 years.

30-597 - 0 - 90- 8

Yield increases of this magnitude are extremely unlikely over any extended period of time. While the growth of yield of individual crops can attain this rate, total agricultural production has rarely exceeded 2.0 percent per anuum over substantial periods of time.

The notable exception to this rule is China, which achieved its 4.4 percent growth rate (noted above) in spite of a slight decrease in cultivated area. The key to China's success was extremely rapid growth of fertilizer consumption.

This suggests strongly that in Sub-Saharan Africa, **both** cultivated area **and** yield must increase at around 2.0 percent per annum to provide any practical possibility of reaching the growth target. These two components of agricultural growth are discussed in the next two sections.

Cultivated Area

The subject of cultivated area in Sub-Saharan Africa has some rather paradoxical aspects. As shown in Table 1, while cultivated area has been growing at a rate of around 0.5 percent, the population economically active in agriculture has been growing at a rate of 1.8% pa over the 1980-87 period.[4] This means that the number of agricultural workers per hectare of cultivated land has been increasing at a rate of about 1.3 percent per annum.

In addition, as shown in Tables 2, 3 and 4, the annual rate of growth of agricultural production over the 1980-87 period has been 2.3 percent. (The growth of total food production has been 2.1 percent and non-food production 3.4 percent.)[5] Thus, agricultural production per agricultural worker has been increasing by 0.5% pa.

These figures indicate that farmers in Sub-Saharan Africa have chosen the intensive, yield-increasing, path even though labor per hectare is increasing. This, in turn, implies that the supply of additional land available for cultivation in Sub-Saharan Africa is constrained.

This finding appears to contradict an estimate by the United Nations Food and Agriculture Organization that there are about 600 million hectares of potentially cultivable land in Sub-Saharan Africa, which would be almost four times the 146 million hectares now under cultivation.[6] The use of intensive practices does, however, tend to confirm the FAO judgment that "land surplus" is one of the "Four Myths About African Agriculture".[7] This finding also conflicts with some of the positions of Binswanger and Pingali (1988) who contend that there is considerable scope for expansion of land-intensive agriculture in Sub-Saharan Africa.

Table 1

SUB-SAHARAN AFRICA: CULTIVATED AREA
(FAO, 1988)

Country	1970-87	1970-80	1980-87	1970	1975	1990	1983	1984	1986	1987
ANGOLA	0.1%	0.1%	0.0%	3460	3500	3500	3500	3500	3500	3500
BENIN	0.8%	1.2%	0.4%	1600	1770	1795	1806	1818	1838	1840
BOTSWANA	0.9%	1.5%	0.0%	1170	1330	1360	1360	1360	1360	1360
BURKINA FASO	2.0%	1.4%	2.9%	2236	2536	2563	2633	2633	2650	3140
CHAD	0.6%	0.8%	0.2%	2900	3000	3150	3150	3150	3205	3205
COTE D'IVOIRE	1.6%	3.4%	-0.9%	2770	3500	3880	3985	4025	3620	3640
ETHIOPIA	0.3%	0.5%	0.1%	13250	13730	13880	13930	13930	13930	13930
GAMBIA	1.6%	1.8%	1.2%	130	152	156	160	165	167	170
GHANA	0.6%	0.7%	0.6%	2574	2700	2760	2770	2820	2860	2870
GUINEA	0.0%	0.0%	0.1%	1570	1570	1570	1575	1576	1577	1577
GUINEA BISSAU	1.2%	0.4%	2.3%	275	285	285	287	290	335	335
LESOTHO	-0.3%	-2.3%	1.3%	368	372	232	298	298	300	320
LIBERIA	0.1%	0.1%	0.0%	366	366	371	371	371	371	371
MADAGASCAR	1.5%	2.4%	0.3%	2370	2759	3000	3011	3020	3065	3067
MALAWI	0.7%	1.0%	0.3%	2108	2278	2320	2344	2345	2376	2376
MALI	1.0%	1.6%	0.2%	1750	1850	2050	2053	2053	2076	2076
MAURITANIA	-2.0%	-3.7%	0.3%	283	196	195	195	195	199	199
MAURITIUS	0.1%	0.2%	0.0%	105	106	107	107	107	107	107
MOZAMBIQUE	0.2%	0.2%	0.0%	3009	3080	3080	3080	3080	3090	3090
NAMIBIA	0.1%	0.1%	0.1%	651	653	657	662	662	662	662
NIGER	1.6%	2.8%	-0.0%	2700	2154	3552	3780	3760	3750	3540
SENEGAL	0.6%	1.0%	0.0%	4750	5000	5225	5225	5225	5225	5225
SIERRA LEONE	1.1%	1.7%	0.3%	1490	1600	1766	1771	1771	1796	1801
SOMALIA	-0.5%	0.4%	-1.9%	1022	1055	1066	1066	1066	1081	933
SUDAN	0.4%	0.6%	0.1%	11700	12160	12417	12448	12448	12478	12478
SWAZILAND	0.4%	2.2%	-2.0%	152	170	189	141	144	180	164
TOGO	0.1%	0.1%	0.1%	1406	1415	1420	1427	1427	1429	1431
ZAMBIA	0.3%	0.3%	0.3%	4950	5000	5108	5158	5158	5198	5208
ZIMBABWE	0.9%	0.6%	1.2%	2382	2524	2539	2682	2682	2767	2769
MID-AFRICA										
BURUNDI	0.6%	0.8%	0.3%	1200	1255	1305	1306	1309	1330	1332
CAMEROON	0.9%	1.5%	0.1%	5978	6395	6930	6960	6965	6990	6995
CENT. AF. REP.	0.5%	0.6%	0.4%	1830	1830	1945	1970	1982	2004	2005
CONGO, PR	0.5%	0.7%	0.2%	627	652	669	673	675	679	679
GABON	2.3%	4.9%	0.0%	280	369	452	452	452	452	452
KENYA	0.9%	0.9%	0.9%	2080	2240	2270	2310	2335	2370	2420
NIGERIA	0.3%	0.2%	0.4%	29900	30000	30385	30435	31035	31335	31335
RWANDA	2.3%	3.3%	2.0%	704	912	975	1010	1010	1113	1120
TANZANIA	0.5%	0.7%	0.2%	4820	5030	5160	5190	5190	5215	5230
UGANDA	1.8%	1.3%	2.4%	4980	5407	5680	6300	6500	6705	6705
ZAIRE	0.7%	0.7%	0.8%	5896	6100	6314	6460	6510	6650	6690
TOTALS										
MID-AFRICA	0.6%	0.6%	0.7%	58295	60250	62085	63066	63962	64843	64963
OTHER	0.6%	0.9%	0.2%	73497	76811	80253	80975	81079	81182	81384
S-S AFRICA	0.6%	0.8%	0.4%	131792	137061	142338	144041	145041	146025	146347

Table 2

Agricultural production

	Index, 1979–81 = 100								Average annual growth rate			
	1980	*1981*	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1975-80*	*1980-85*	*1986*	*1987*
SUB-SAHARAN AFRICA	100	103	105	104	104	114	118	117	1.1	1.8	4.0	-1.1
Excluding Nigeria	99	103	105	103	102	112	116	116	0.8	1.6	4.0	-0.7
IDA-eligible countries	99	103	106	105	103	111	117	116	0.9	1.6	4.8	-0.9
Benin	98	96	98	101	130	134	145	145	4.0	7.4	8.2	0.0
Burkina Faso	95	102	104	106	104	129	148	137	1.6	4.7	14.7	-7.4
Burundi	95	110	103	106	101	112	117	118	0.7	1.7	4.5	0.9
Cape Verde	125	89	90	79	94	83	116	128	7.0	-5.6	39.8	10.3
Central African Rep.	101	102	107	106	108	111	114	116	1.4	1.8	2.7	1.8
Chad	102	96	102	110	95	109	110	109	1.3	1.1	0.9	-0.9
Comoros	106	95	101	108	106	113	113	115	2.6	2.1	0.0	1.8
Djibouti	..	..	..	..	..	..	..	..	..	..	..	..
Equatorial Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Ethiopia	99	99	107	102	91	99	107	102	3.5	-0.9	8.1	-4.7
Gambia, The	87	124	155	110	118	134	150	138	-11.1	4.9	11.9	-8.0
Ghana	101	98	94	88	116	114	119	118	-3.5	3.0	4.4	-0.8
Guinea	102	103	105	101	102	102	106	107	1.3	-0.2	3.9	0.9
Guinea-Bissau	96	108	120	105	126	126	136	146	-0.3	4.9	7.9	7.4
Kenya	99	99	111	108	91	110	122	117	2.2	0.7	10.9	-4.1
Lesotho	99	106	100	101	104	111	108	111	2.3	1.5	-2.7	2.8
Liberia	101	102	103	106	115	113	115	115	2.5	2.8	1.8	0.0
Madagascar	103	103	103	106	110	112	112	118	0.7	1.9	0.0	5.4
Malawi	98	102	108	106	111	113	112	111	4.1	2.7	-0.9	-0.9
Mali	99	104	110	115	104	110	117	114	3.0	1.6	6.4	-2.6
Mauritania	100	102	99	94	94	96	103	104	5.0	-1.4	7.3	1.0
Mozambique	100	102	99	91	90	91	93	94	0.1	-2.6	2.2	1.1
Niger	103	98	98	96	82	99	104	96	9.6	-2.1	5.1	-7.7
Rwanda	97	106	110	113	103	105	108	112	3.7	1.0	2.9	3.7
São Tomé and Principe	92	96	92	92	78	79	79	79	-0.8	-3.9	0.0	0.0
Senegal	81	125	133	84	103	109	122	135	-11.1	1.3	11.9	10.7
Sierra Leone	100	99	111	111	99	99	113	114	0.2	-0.1	14.1	0.9
Somalia	101	103	108	102	104	115	121	123	1.3	1.8	5.2	1.7
Sudan	100	110	103	108	103	115	118	109	2.2	1.6	2.6	-7.6
Tanzania	100	103	98	101	106	104	109	112	3.4	0.9	4.8	2.8
Togo	101	101	99	96	102	116	119	122	2.3	2.0	2.6	2.5
Uganda	100	104	117	121	104	139	142	143	-4.5	4.9	2.2	0.7
Zaire	101	103	108	111	113	117	118	121	0.1	3.0	0.9	2.5
Zambia	102	100	94	101	105	116	124	122	-4.8	2.5	6.9	-1.6
Middle-income economies	101	104	104	101	106	118	121	119	1.4	2.4	2.6	-1.6
Middle-income oil importers	96	108	99	96	99	121	120	118	1.8	2.5	-1.0	-1.6
Botswana	83	106	111	102	97	92	88	90	-3.6	0.5	-4.3	2.3
Côte d'Ivoire	96	109	96	99	98	123	119	124	3.6	2.8	-3.3	4.2
Mauritius	87	100	120	101	100	110	116	118	0.9	2.9	5.5	1.7
Seychelles	..	..	..	..	..	..	..	..	..	..	..	..
Swaziland	104	107	108	109	111	112	129	122	4.4	1.4	15.2	-5.4
Zimbabwe	97	109	100	85	100	124	123	108	-1.2	2.3	-0.8	-12.2
Middle-income oil exporters	103	102	106	103	109	118	122	120	1.3	2.4	3.9	-1.6
Angola	105	98	99	98	98	98	100	102	-5.3	-1.0	2.0	2.0
Cameroon	100	101	101	95	105	106	111	115	0.7	1.0	4.7	3.6
Congo, People's Rep.	100	102	106	104	104	110	110	112	1.3	1.5	0.0	1.8
Gabon	102	100	105	106	105	103	106	108	3.4	0.6	2.9	1.9
Nigeria	104	102	107	105	111	122	126	123	2.2	3.0	3.3	-2.4
NORTH AFRICA	104	97	104	106	106	117	121	122	1.4	2.5	3.7	0.1
Algeria	109	99	91	99	106	121	124	130	-1.4	2.3	2.5	4.8
Egypt, Arab Rep.	101	100	105	106	106	113	114	120	2.0	2.2	0.9	5.3
Libya	104	103	121	119	112	124	104	109	1.2	3.2	-16.1	4.8
Morocco	106	89	117	106	107	119	143	116	3.7	3.0	20.2	-18.9
Tunisia	111	98	85	111	102	129	117	132	-0.9	3.3	-9.3	12.8
ALL AFRICA	101	102	105	104	104	114	119	118	1.1	2.0	4.0	-0.9

Table 3

Food production

	Index, 1979–81 = 100								Average annual growth rate			
	1980	*1981*	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1975-80*	*1980-85*	*1986*	*1987*
SUB-SAHARAN AFRICA	100	103	105	103	103	113	116	116	1.5	1.7	4.4	-2.0
Excluding Nigeria	99	104	105	103	101	111	116	114	1.1	1.4	4.5	-1.8
IDA-eligible countries	99	103	105	104	101	110	116	114	1.1	1.2	5.2	-1.5
Benin	99	97	96	97	121	126	132	130	4.5	5.5	4.8	-1.5
Burkina Faso	95	103	103	105	103	126	142	130	1.1	4.2	12.7	-8.5
Burundi	98	107	106	105	102	115	118	119	0.4	1.9	2.6	0.8
Cape Verde	127	89	90	79	95	84	117	129	7.2	-5.6	39.3	10.3
Central African Rep.	100	103	106	107	105	112	115	117	1.7	1.8	2.7	1.7
Chad	102	97	100	102	93	107	109	107	3.7	0.4	1.9	-1.8
Comoros	106	95	101	106	106	112	112	115	2.9	1.9	0.0	2.7
Djibouti	..	..	..	..	..	..	..	..	..	..	..	..
Equatorial Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Ethiopia	99	98	107	100	93	100	109	104	3.6	-0.5	9.0	-4.6
Gambia, The	87	124	155	110	119	135	150	138	-11.4	5.1	11.1	-8.0
Ghana	101	98	94	87	116	114	120	119	-3.4	3.0	5.3	-0.8
Guinea	102	104	106	100	102	102	106	107	1.3	-0.3	3.9	0.9
Guinea-Bissau	95	107	119	105	125	125	135	145	-0.7	5.0	8.0	7.4
Kenya	99	97	112	108	81	106	119	113	1.7	-0.7	12.3	-5.0
Lesotho	98	106	100	100	102	110	107	110	2.1	1.3	-2.7	2.8
Liberia	98	104	104	111	115	114	116	115	2.1	3.3	1.8	-0.9
Madagascar	103	103	104	107	110	113	113	119	0.9	2.0	0.0	5.3
Malawi	98	103	107	103	105	106	106	105	3.3	1.2	0.0	-0.9
Mali	98	106	113	117	103	108	115	109	2.1	1.2	6.5	-5.2
Mauritania	100	102	99	94	94	96	103	104	5.0	-1.4	7.3	1.0
Mozambique	101	101	99	92	91	92	95	95	-0.1	-2.4	3.3	0.0
Niger	103	98	98	96	82	99	104	96	9.8	-2.1	5.1	-7.7
Rwanda	97	106	112	111	103	103	106	108	3.7	0.6	2.9	1.9
São Tomé and Príncipe	92	96	92	92	78	78	78	79	-0.9	-4.1	0.0	1.3
Senegal	81	124	132	83	101	108	120	134	-11.2	1.0	11.1	11.7
Sierra Leone	101	101	113	116	105	100	112	113	-0.5	0.3	12.0	0.9
Somalia	101	103	108	102	104	115	121	123	1.3	1.8	5.2	1.7
Sudan	100	111	101	104	98	112	118	107	2.9	0.6	5.4	-9.3
Tanzania	100	103	99	103	108	108	112	115	4.0	1.6	3.7	2.7
Togo	100	100	97	94	103	106	108	112	2.4	1.0	1.9	3.7
Uganda	98	106	114	119	94	132	138	138	-3.4	3.4	4.5	0.0
Zaire	100	103	107	109	112	115	116	120	0.4	2.8	0.9	3.4
Zambia	102	100	95	101	102	115	124	117	-5.1	2.1	7.8	-5.6
Middle-income economies	101	104	105	102	109	120	123	120	1.9	2.7	3.0	-3.1
Middle-income oil importers	96	108	103	95	107	124	124	117	2.0	3.4	0.3	-5.5
Botswana	83	106	111	102	97	92	88	89	-3.7	0.5	-4.3	1.1
Côte d'Ivoire	100	104	99	100	119	131	130	132	5.5	5.2	-0.8	1.5
Mauritius	86	99	121	100	97	107	114	116	0.6	2.4	6.5	1.8
Seychelles	..	..	..	..	..	..	..	..	..	..	..	..
Swaziland	103	107	108	109	111	112	131	123	4.1	1.5	17.0	-6.1
Zimbabwe	91	119	104	80	85	120	119	89	-3.2	0.3	-0.8	-25.2
Middle-income oil exporters	103	102	106	104	109	119	123	120	1.9	2.6	3.8	-2.5
Angola	101	100	101	102	102	102	104	105	-0.1	0.3	2.0	1.0
Cameroon	99	101	99	100	100	107	110	111	-0.3	1.1	2.8	0.9
Congo, People's Rep.	100	102	107	104	106	110	112	114	0.9	1.6	1.8	1.8
Gabon	102	99	103	105	104	102	104	107	3.4	0.5	2.0	2.9
Nigeria	104	103	108	105	111	122	127	123	2.4	2.9	4.1	-3.1
NORTH AFRICA	104	97	105	108	108	119	124	124	1.1	2.9	4.6	0.0
Algeria	109	99	88	94	103	117	120	126	-1.7	1.6	2.6	5.0
Egypt, Arab Rep.	100	100	107	110	110	117	120	127	1.1	3.2	2.6	5.8
Libya	104	103	122	120	112	125	103	109	1.3	3.4	-17.6	5.8
Morocco	106	88	117	106	107	119	144	116	4.0	3.1	21.0	-19.4
Tunisia	111	98	85	111	102	129	117	132	-1.0	3.3	-9.3	12.8
ALL AFRICA	101	102	105	104	104	114	120	118	1.3	2.0	4.4	-1.6

Table 4

Nonfood production

	Index, 1979–81 = 100								Average annual growth rate			
	1980	*1981*	*1982*	*1983*	*1984*	*1985*	*1986*	*1987*	*1975-80*	*1980-85*	*1986*	*1987*
SUB-SAHARAN AFRICA	101	102	102	107	108	116	117	126	-1.5	2.7	0.4	8.1
Excluding Nigeria	101	102	103	108	109	117	118	127	-1.3	2.9	0.6	7.5
IDA-eligible countries	101	101	108	116	121	122	124	130	-1.1	4.6	1.1	5.2
Benin	90	85	156	207	407	402	545	621	-3.7	42.8	35.6	13.9
Burkina Faso	95	89	117	122	121	168	218	218	8.1	11.5	29.8	0.0
Burundi	69	139	75	116	94	89	106	115	6.6	1.5	19.1	8.5
Cape Verde	57	104	104	61	61	43	69	71	-5.9	-9.6	60.5	2.9
Central African Rep.	101	94	115	102	125	104	103	109	-1.4	2.6	-1.0	5.8
Chad	103	87	126	199	118	126	116	133	-13.4	7.0	-7.9	14.7
Comoros	77	91	137	108	112	131	131	133	-6.4	9.1	0.0	1.5
Djibouti	..	..	..	..	..	..	..	..	..	..	..	..
Equatorial Guinea	..	..	..	..	..	..	..	..	..	..	..	..
Ethiopia	98	104	105	115	77	90	94	93	2.1	-3.5	4.4	-1.1
Gambia, The	68	128	116	69	97	111	111	111	..	3.2	0.0	0.0
Ghana	103	100	100	105	110	87	76	88	-11.2	-1.4	-12.6	15.8
Guinea	100	100	101	103	104	105	106	106	0.9	1.1	1.0	0.0
Guinea-Bissau	129	166	191	112	187	187	187	187	64.2	4.9	0.0	0.0
Kenya	101	108	108	108	137	128	135	138	5.7	5.6	5.5	2.2
Lesotho	102	103	104	115	123	123	123	123	3.5	4.6	0.0	0.0
Liberia	108	97	100	92	116	109	112	114	3.6	1.4	2.8	1.8
Madagascar	97	102	99	98	103	106	110	113	-2.2	1.3	3.8	2.7
Malawi	98	99	111	121	134	138	137	135	7.5	8.0	-0.7	-1.5
Mali	116	83	78	104	112	131	139	155	14.8	5.3	6.1	11.5
Mauritania	..	..	..	..	..	..	..	..	..	..	..	..
Mozambique	99	108	94	80	86	83	78	78	3.4	-4.8	-6.0	0.0
Niger	98	84	89	95	101	113	113	117	-14.3	3.9	0.0	3.5
Rwanda	91	111	93	134	107	130	127	162	3.1	6.0	-2.3	27.6
São Tomé and Principe	100	100	100	100	100	100	100	100	14.2	0.0	0.0	0.0
Senegal	72	139	176	111	176	149	176	186	-9.6	11.7	18.1	5.7
Sierra Leone	93	85	80	52	28	91	132	134	11.4	-10.5	45.1	1.5
Somalia	118	64	165	142	110	110	110	110	-3.4	3.3	0.0	0.0
Sudan	99	87	125	158	170	158	124	141	-6.1	14.0	-21.5	13.7
Tanzania	102	105	85	82	87	72	83	87	-1.2	-6.5	15.3	4.8
Togo	115	110	113	112	95	199	220	215	-0.2	6.8	10.6	-2.3
Uganda	119	87	147	145	194	196	177	188	-11.8	15.0	-9.7	6.2
Zaire	108	100	126	129	126	137	141	148	-5.2	5.6	2.9	5.0
Zambia	103	92	74	102	181	134	131	240	4.5	11.0	-2.2	83.2
Middle-income economies	100	104	91	89	85	105	104	119	-2.3	-1.2	-1.2	14.8
Middle-income oil importers	97	108	89	97	76	112	107	119	1.1	-0.6	-4.9	11.7
Botswana	100	100	100	100	100	100	100	100	0.0	0.0	0.0	0.0
Côte d'Ivoire	88	120	87	96	44	101	93	101	-0.7	-6.2	-7.9	8.6
Mauritius	95	108	99	116	150	149	148	155	5.3	10.2	-0.7	4.7
Seychelles	..	..	..	..	..	..	..	..	..	..	..	..
Swaziland	119	110	110	110	110	110	110	110	9.1	-1.1	0.0	0.0
Zimbabwe	113	85	90	98	134	132	131	152	3.5	6.6	-0.8	16.0
Middle-income oil exporters	108	95	96	70	104	89	97	119	-7.2	-2.8	8.9	22.2
Angola	136	83	76	65	69	62	67	79	-23.4	-12.4	8.1	17.9
Cameroon	104	101	113	73	126	98	115	137	6.5	-0.2	17.3	19.1
Congo, People's Rep.	96	94	77	113	79	117	81	81	8.3	2.5	-30.8	0.0
Gabon	120	132	327	247	212	230	238	247	21.8	13.4	3.5	3.8
Nigeria	100	89	71	63	77	84	76	106	-8.4	-4.0	-9.5	39.5
NORTH AFRICA	104	100	95	91	89	99	93	94	5.2	-1.8	-5.8	0.5
Algeria	101	106	146	188	174	196	157	204	4.1	15.5	-4.6	9.1
Egypt, Arab Rep.	105	98	90	79	79	87	81	80	6.7	-4.8	-6.9	-1.2
Libya	100	101	102	103	105	109	111	114	-1.2	1.6	1.8	2.7
Morocco	97	110	106	124	113	135	135	138	-6.3	5.5	0.0	2.2
Tunisia	97	107	105	108	102	114	119	121	6.2	2.0	4.4	1.7
ALL AFRICA	102	101	101	103	104	113	112	120	-0.3	1.8	-0.7	6.8

Clearly, the conflict about cultivated area in Sub-Saharan Africa needs to be resolved if policies and programs are to be correctly formulated. There are several plausible hypotheses concerning this conflict.

First, the use of the term "potentially cultivable" is highly ambiguous. Virtually any land would be cultivable under appropriate economic conditions. Second, the FAO estimate of 600 million hectares cited above may simply be wrong. It undoubtedly is wrong to some degree; however, it is unlikely to be wrong by so great a margin, so consistently across so many countries, to make the estimate irrelevant. Third, the FAO study deliberately omitted from consideration important economic and institutional factors that may severely constrain the ability to expand the area of cultivated land in Sub-Saharan Africa.

Several possible factors quickly spring to mind.

- Some of the poten[illegible]d may be too remote from settlements, transportation and markets to be [illegible] without large infrastructural investments.

- Much of the potential area consists of highly acidic soils. While liming can alleviate this problem, it is a technology currently far beyond the infrastructural and economic capacities of most of Sub-Saharan Africa.

- A large part of the arable land of Sub-Saharan Africa is farmed under shifting cultivation. The land is cleared and burned, and then farmed for one or two years, after which it is returned to fallow for a period of seven to twenty years. This means that there is much more area tied up in fallow than is presently being farmed. It is not inconceivable that most of the potentially cultivable land is already being used in fallow and, therefore, that there is very little room for expansion under present practices.

- The land need for livestock in Sub-Saharan Africa is enormous. According to FAO data, the amount of land in permanent pastures is over four times the amount of cultivated land. Of course a substantial amount of this land may of the nature of a residual amount that is rarely used. Nevertheless, grazing rights to pasture land are zealously guarded by livestock owners and kept from crop production. It is likely that Sub-Saharan Africa, like all developing countries, will have to go through the painful process of rationalizing its livestock and crop lands.

There probably are other major constraints on expansion of crop land; certainly this is an area deserving intensive empirical research. Perhaps the most urgent research need is to find out what is actually happening in the use of agricultural and other land in Sub-Saharan Africa. This is a research area where remote image sensing would prove especially useful.

Pending this research, some idea of the potential for expanding cultivated area must be obtained. In this connection, it is important to realize that the same agricultural inputs necessary to increase yields -- irrigation, improved seed varieties and fertilizers -- can also increase cultivated area.

Irrigation brings arid land into production and extends multiple cropping into the dry seasons. Improved varieties allow cultivation of crops in tight agroecological niches where short growing seasons, photosensitivity, precipitation patterns and the like are constraining factors.

Inorganic fertilizer also can be a powerful land increasing technology. First, the ability to grow more fodder crops and to utilize more crop residues decreases the need for tieing up large amounts of land for livestock. Second, shifting cultivation is primarily a nutrient scavenging system. The use of fertilizers can make this system unnecessary, resulting in settled agriculture.

Fertilizers and settled farming have the additional advantages that biomass need not be burned off and can be recycled for soil quality improvement. Farmers can afford to invest more in soil and water conservation measures on limited areas of the best land, leaving marginal areas to forests and pastures. These are environmental advantages of fertilizers that should be more widely appreciated.

In sum, it appears that with favorable economic incentives, sufficient land may be taken out of long fallow rotations and pastures to increase cultivated area at a rate of 2.0% pa for at least the next 20 years. It should be noted that this rate is higher than the 1.8% pa rate of growth of the agricultural labor force. This implies that more agricultural power through livestock and mechanization will be required. It is also possible that with a better living, more workers will stay in agriculture.

For example, with the recent rise of agricultural prices and income in Nigeria there has indeed been a movement of labor and capital from urban areas to agriculture.

Yields

To meet the growth targets described above, average yield of the major crops in Sub-Saharan Africa must grow at an average annual rate of 2.0 percent per annum, or by about 50 percent over the 20-year period.

As explained in Chapter 3 below, a review of the literature and discussions with experts indicate that in areas with reasonably favorable agroclimatic conditions -- like most of Mid-Africa -- the seed varieties now being used for most crops in Sub-Saharan Africa are capable of supporting at least a 50 percent increase in average yield.

Most authorities believe that a 100 percent increase over present low levels is attainable with modest increases in fertilizer use and improved soil fertility.

Thus, with certain possible exceptions, the constraint on yield is not germplasm, but policies and inputs: producer returns, fertilizers, irrigation, transportation, and the like.

This means that Sub-Saharan Africa can concentrate on these short-term leading inputs to achieve rapid growth of production. There is no need to wait for research to produce the basic seed technology for rapid growth of agricultural production.

It also should be emphasized, however, that this conclusion is based on the very low yields now being obtained in Sub-Saharan Africa. As yield levels increase, it will become increasingly difficult to maintain growth momentum. Crops in Sub-Saharan Africa are widely afflicted by insects, pests, drought and adverse soil conditions. Continuing research to produce resistant varieties and crops more suited to specific rainfall and soil conditions is very important.

While we agree with Binswanger and Pingali (1988) on this subject, we do not agree that research on higher-yielding varieties should be neglected. Higher-yielding varieties will be needed in the next twenty years or so, and research must be conducted now if they are to be available in time. It would be a great boon to African farmers to have these varieties sooner.

Finally, it is clear that increasing average yields at this rate -- while simultaneously increasing cultivated area by 2.0 percent per year -- will require agricultural power inputs far beyond the existing capacities of human labor, livestock and machinery in Sub-Saharan Africa. It will also require substantial development of the agricultural infrastructure of irrigation and transportation facilities.

These additional leading inputs for development of Sub-Saharan Africa are further discussed in the specific context of Mid-Africa in the next chapter.

Footnotes

1 World Bank, World Development Report 1989, Table 2.

2 See, for example, the discussion of "Economic Policy Adjustment in Developing Countries," in the American Journal of Agricultural Economics, December, 1988.

3 The first of these reports is United Nations Food and Agriculture Organization, African Agriculture: The Next 25 Years (Rome: FAO, 1986). Although the FAO report does not present much detailed agroclimatic data, it makes use of a number of previous FAO studies, such as the organization's extensive soil mapping project. The other reference is to the studies of P. Buringh, H.D.J. van Heemst and G.J. Staring, "Computation of the Absolute Maximum Food Production of the World," a contribution to the research project on Problems of Population Doubling and Food Supply (Wageningen, Netherlands: Agricultural University of Wageningen, Department of Tropical Soil Science, 1975).

4 United Nations Food and Agriculture Organization, Production Yearbook 1988 (Rome: FAO, 1989).

5 United Nations Development Programme and the World Bank, African Economic and Financial Data (Washington, DC: The World Bank, 1989).

6 See, for example, FAO, African Agriculture: The Next 25 Years, Main Report (Rome: FAO, 1986), p. 12.

7 Ibid., p. 13. It is a curious fact that the same FAO report, in the space of two pages, refers to a potentially cultivable area of 600 million hectares in Sub-Saharan Africa, and then goes on to dismiss the notion of land surplus as a "myth."

CHAPTER 2

MID-AFRICA REGION: AN OVERVIEW

Mid-Africa: A Description

A number of different studies have sought to delineate areas in Africa with differing potential for agriculture. The exact borderlines of agroclimatic zones vary slightly from study to study, but the general contours and divisions tend to run parallel. Based on two of these studies (FAO and Buringh et al.), we have chosen to focus on an area of relatively high rainfall and adequate soils that stretches across the African continent.[1]

The region, which we have designated "Mid-Africa," consists of 11 countries. (See map in Executive Summary.) Included in the region are parts of Nigeria, Cameroon, Gabon, Congo, Central African Republic, Zaire, Uganda, Rwanda, Burundi, Kenya, and Tanzania.

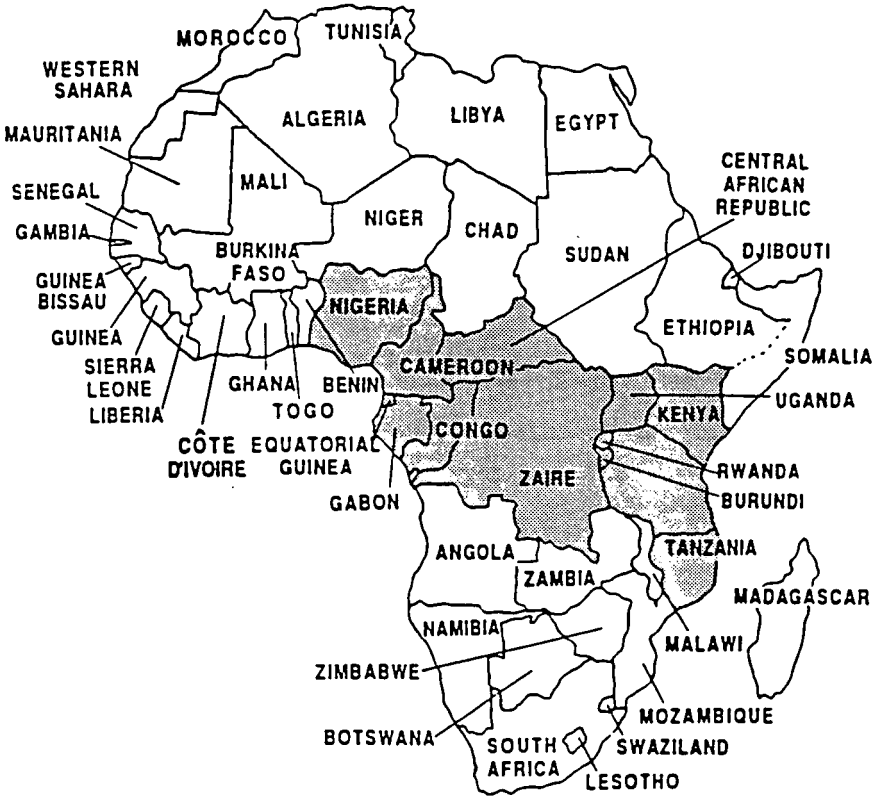
The country borders do not, of course, match the outlines of the agroclimatic zone. As shown in Map 1 (below), portions of other countries are included in the zone, but these countries will not be addressed specifically in the report. Most notably, we have omitted the humid areas of Ethiopia, the Sudan, Chad and Mali, although we believe that the agricultural potential of these areas may be extremely high.[2]

Likewise, some parts of these 11 countries do not fall into the relevant zone (e.g., northern Nigeria). This paper will use the two definitions of Mid-Africa -- political and agroclimatic -- as appropriate and convenient throughout the paper. It is worth noting also that the Mid-Africa region does not represent a single, homogeneous agroecological zone; several major sub-zones can be defined, and numerous micro-zones exist. Nonetheless, the Mid-Africa region poses an interesting area for study.

The 11 countries of Mid-Africa account for 42 percent of the population of Sub-Saharan Africa; an increase in agricultural production in this region would thus make an important contribution towards improving the situation for the whole continent.[3]

In addition to its agroclimatic potential, Mid-Africa also contributes a large share of the economic activity of Sub-Saharan Africa. The 11 countries account for a striking 67.1 percent of the region's gross national product (GNP).[4] The average per capita GNP

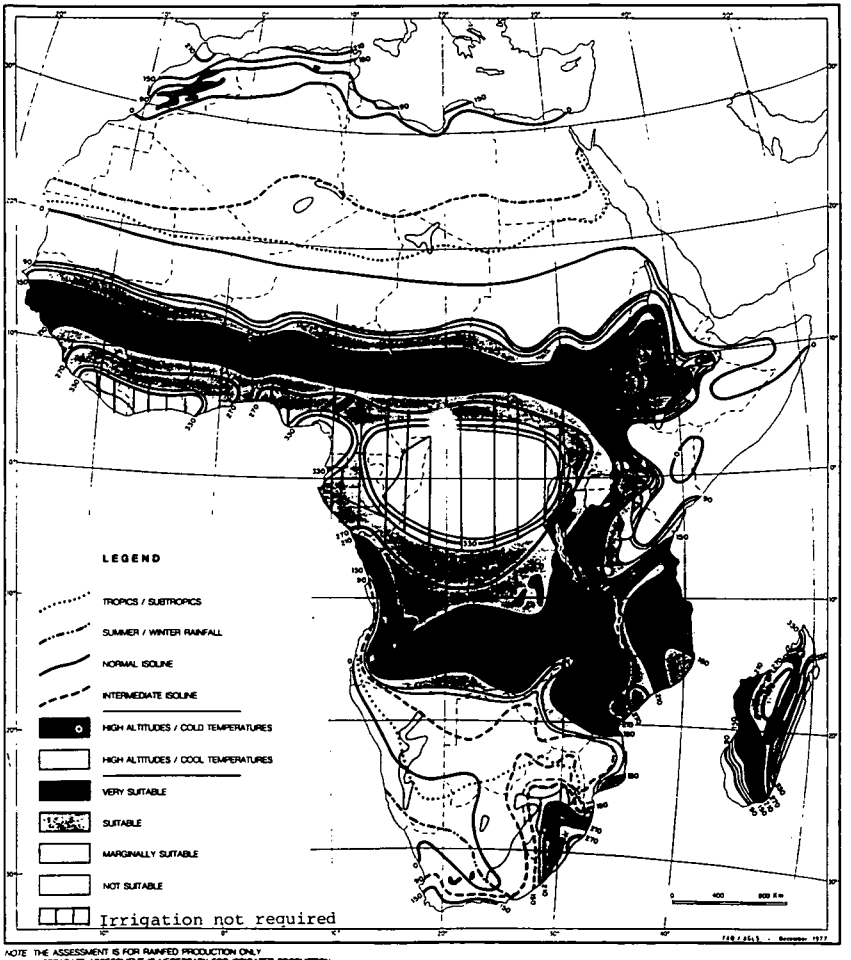
Map 1


MOROCCO
TUNISIA
WESTERN SAHARA
ALGERIA
LIBYA
EGYPT
MAURITANIA
MALI
SENEGAL
GAMBIA
NIGER
CHAD
CENTRAL AFRICAN REPUBLIC
SUDAN
DJIBOUTI
BURKINA FASO
GUINEA BISSAU
NIGERIA
ETHIOPIA
GUINEA
SOMALIA
SIERRA LEONE
LIBERIA
GHANA
BENIN
TOGO
CAMEROON
UGANDA
KENYA
CÔTE D'IVOIRE
EQUATORIAL GUINEA
CONGO
ZAIRE
RWANDA
BURUNDI
GABON
ANGOLA
TANZANIA
ZAMBIA
MADAGASCAR
NAMIBIA
MALAWI
ZIMBABWE
MOZAMBIQUE
BOTSWANA
SOUTH AFRICA
SWAZILAND
LESOTHO

MAIZE

GENERALIZED AGRO-CLIMATIC SUITABILITY ASSESSMENT FOR
RAINFED PRODUCTION

Map 2



NOTE THE ASSESSMENT IS FOR RAINFED PRODUCTION ONLY
A SEPARATE ASSESSMENT IS NECESSARY FOR IRRIGATED PRODUCTION

is $588 per person, which is low by world standards, but far better than the level of the Sudano-Sahelian countries to the north.[5]

According to research by FAO, the Mid-Africa zone provides some of the best suited growing conditions in Africa for a large number of food crops. Map 2 presents an FAO assessment of areas suitable for rainfed maize production in Africa. Suitability maps for other crops (e.g., cassava, pulses, sorghum and millet) follow the same general contours and shapes, although the size of the areas vary slightly.

One exception to Mid-Africa's general suitability for crop production is a large area of unexploited tropical rainforest in the center of the region. This rainforest, displayed as a blank hole in the center of Map 2, is classified as "not suitable" for production of any crops other than cassava. For the most part, this region should remain untouched in the future. The rainforests of Zaire, Congo, and other countries comprise one of the world's great ecological reserves and stores of genetic diversity. Increasing agricultural production and other economic opportunities outside the rainforest zones should help to reduce population pressures on these unique tropical ecosystems.

Apart from their high potential for agricultural production, the countries of Mid-Africa obviously differ enormously among themselves in social, cultural, political and economic factors. Some of the differences are readily apparent. For instance, Gabon ranks as a middle-income oil exporter, with per capita GNP almost 20 times the level of Zaire. Nigeria stands as the most populous country in Africa, with almost one quarter of the population of Sub-Saharan Africa. Zaire has a land mass almost one hundred times larger than that of Rwanda or Burundi.[6]

Beyond these crude aggregate statistics, the countries differ in other factors of crucial importance to their present-day situations: ethnic backgrounds, natural resources, colonial experiences, infrastructure development, and human resources, to name a few. This will by necessity shape the program recommendations for specific countries.

From an agroclimatic perspective, Mid-Africa can be divided into two important sub-zones: the humid lowlands of West and Central Africa, and the mountainous highlands of Eastern Africa.[7] The highland region includes parts of Zaire, Uganda, Tanzania, Kenya, Rwanda, and Burundi. The lowlands include parts of Nigeria, Cameroon, Gabon, Congo, CAR, and Zaire.

Table 1. Mid-Africa -- population and national income.

Country	Pop. (millions)	GNP/Capita	GNP (US$billion)
Burundi	4.8	240	1.2
Cameroon	10.5	910	9.6
CAR	2.7	290	0.8
Congo	2.0	990	2.0
Gabon	1.0	3,080	3.1
Kenya	21.2	300	6.4
Nigeria	103.1	640	66.0
Rwanda	6.2	290	1.8
Tanzania	23.0	250	5.8
Uganda	15.2	230	3.5
Zaire	31.7	160	5.1
Totals	**179.0**	**588**	**105.3**
Sub-Sah. Africa	**424.1**	**370**	**156.9**
Mid-Africa without Nigeria	**75.9**	**518**	**39.3**
Sub-Sah. Africa without Nigeria	**321.0**	**283**	**90.9**

Source: World Bank, World Development Report 1988 (Washington, DC: The World Bank, 1989), Table 1, pp. 222-223.

In general terms, the humid lowlands comprise a mix of forest and savannah. They are lightly populated and farmed under varying systems of shifting cultivation and "bush fallow." The mountainous highlands feature more fertile soils, cooler temperatures, and good rainfall patterns. Population densities reach extremely high levels in places, however, and farmers employ complex systems of mixed cropping.[8]

The principle commonality between the two sub-zones, and between the various countries of Mid-Africa, is the presence of generally favorable rainfall conditions. By definition, the Mid-African agroclimatic zone has high rainfall levels -- generally from

1000-2000 mm per year.[9] Perhaps more important, however, is the reliability of this rainfall. According to FAO studies, most of the Mid-African region varies from normal, on average, by less than 20 percent. This ranks as the lowest level of rainfall variability in all of Africa.[10]

In contrast, the Sudano-Sahelian zone to the north of Mid-Africa suffers acute problems with rainfall deficiency and variability. Rainfall levels are low (400-600 mm), and they vary from normal by more than 30 percent in most years. In describing this zone, the FAO notes that "the potential for rainfed cultivation is low due to the extreme variation in annual rainfall."[11]

The Sudano-Sahelian zone is often regarded as one of the most critical in Africa for agriculture. Its susceptibility to drought and its poor economic situation place the region particularly in need of secure sources of food. With the high-potential zone of Mid-Africa so nearby, there is some reason to hope that an increase in Mid-Africa's agricultural productivity could benefit some of the adjacent countries where needs are critical, both through movement of food and through migration of people.

Agriculture in Mid-Africa

Mid-Africa's fertile environment makes possible the production of a wide range of crops, from rubber to peanuts, and from pineapple to cocoyams. The relative importance of these crops varies considerably from locale to locale. Cassava, for instance, is far more important in Zaire than in Kenya, and maize rates more highly in Tanzania than in Congo. In general, however, we can identify half a dozen food crops and a comparable number of cash crops that represent the most important agricultural commodities for Mid-Africa.

The most important food crops are maize, cassava, pulses, banana and plantain, upland rice, and other root crops. Among cash crops, coffee and cotton hold broad importance for the region, followed by cocoa, palm oil, tea, rubber, and sugar, among others.

Livestock figure prominently in the farming systems of Mid-Africa, despite widespread problems with tsetse flies and trypanosomiasis. Cattle are most abundant in dry areas (for example, parts of Kenya and Tanzania), with small ruminants -- notably sheep and goats -- in the more humid parts of the region.

Farmers in Mid-Africa practice a variety of cropping systems. Mixed cropping and intercropping are common in most areas; these systems often combine annual and perennial crops; subsistence and cash crops; and trees with field crops. Livestock also enter into many farmers' production plans.

The relative importance of large-scale commercial farms and smallholder producers varies considerably from country to country. In many countries, relatively small numbers of plantations and commercial enterprises dominate the production of some export cash crops. In addition, medium-sized commercial farms often produce food crops for domestic markets. But many smallholders also produce cash crops for export -- such as coffee and cocoa in West Africa. Smallholders also produce food crops for cash marketing.

Nonetheless, the dominant type of farming in Mid-Africa is subsistence cultivation. Yudelman notes that "few producers in sub-Saharan Africa are outside the market economy; however, most farmers produce a large part of their own subsistence."[12] The same author cites FAO studies indicating that only 27 percent of agricultural production in Sub-Saharan Africa finds its way to major markets. In part because of poor local transportation systems, many coastal cities in Africa import their food from abroad rather than consuming domestic produce. Yudelman reports that "imports and food aid made up more than one-half of the food that was marketed in the early 1980s."[13]

The subsistence nature of agricultural production in Mid-Africa shapes the conditions under which production takes place. Most farmers use negligible amounts of fertilizer, pesticides, machinery and other purchased inputs. Land and human labor represent the main factors of production; not even animal power finds wide use (in large part because of tsetse fly infestations). Even in the mountainous highlands, where population densities are among the world's highest, the use of purchased inputs remains extremely low.[14]

Perhaps most important, virtually all the crop production in Mid-Africa takes place under rainfed conditions. By most estimates, in Sub-Saharan Africa as a whole, less than 5 percent of cultivated land is under irrigation. Of that small total, a large majority is concentrated in three countries: Sudan, Madagascar, and Nigeria.[15] By comparison, over 30 percent of India's cultivated land is irrigated.[16]

This implies that efforts to generate dramatic agricultural growth in Africa will need to address the issues of irrigation and inputs, and will need to focus on the crops that are most readily grown in the region: maize, cassava and other root crops, banana and plantain, upland rice, and beans.

At present, yield levels for these crops in Mid-Africa are strikingly low by world standards. Maize yields, for instance, average only one-third the world average; for Sub-Saharan Africa as a whole, they average about half the level achieved in other developing countries.

Cassava yields similarly trail those in other developing countries. Although Africa accounts for well over half of global cassava area -- with Zaire alone accounting for 15 percent of the world total -- average yields for the continent are only about 60 percent of the aggregate yield for the rest of the world. Since 1975, the continent has averaged about 7 tons per hectare, compared with about 12-14 t/ha for South America and Asia.[17]

Yields for other food crops indicate that comparable disparities exist between Mid-African levels and those prevalent outside of Africa. The persistence of these disparities has led some observers to question whether or not suitable agricultural technologies exist to raise Africa's levels of production.

The next section reviews five of the major technologies and institutional factors that we feel will be **leading inputs** for agriculture in Mid-Africa. These are:

- government policies
- germplasm and crop varieties
- fertilizers and other methods of maintaining and restoring soil fertility
- irrigation
- transportation and marketing

Leading Inputs

This study focuses on five leading inputs for agricultural development in Mid-Africa. The following pages sketch out briefly the importance of each of these for Mid-Africa. Three of the inputs are discussed in greater detail in separate chapters of this study. Chapter Three deals with germplasm and crop varieties; Chapter Four discusses fertilizer and soil fertility; and Chapter Five deals with irrigation.

Seeds and Germplasm

One of the recurring questions concerning agricultural development within Mid-Africa has been whether suitable genetic materials currently exist to bring about substantial gains in productivity.

For many crops, currently available varieties already incorporate significant quantities of improved genetic material that have originated in international research centers and national programs. Most of Mid-Africa's open-pollinated maize varieties, for instance, include CIMMYT germplasm. Similarly, IITA cultivars of cassava have been widely adapted in Nigeria and other countries. (For fuller details, see the attached papers on maize and cassava.)

As a result, Mid-Africa's crop varieties have reasonably high productive potential, and are increasingly resistant to some of the most troubling diseases and pests. Much room clearly remains for varietal improvement, and continual research will be required to retain the gains already made.

In the meantime, however, there is considerable potential for increasing agricultural production with existing varieties. In particular, existing varieties of maize, rice, sorghum, cassava, and other common crops show high responses to fertilizers. This suggests that African agriculture does not need to wait for decades of research before productivity gains can be realized. Research can focus on long-term needs, while substantial short-run production increases can be achieved through more readily available means.

In sum, we have concluded that in many cases, these materials not only exist at research stations or "on-the-shelf," but actually are used widely "on the ground," in farmers' fields.

Irrigation and Water Conservation

Although Mid-Africa is generally a region of adequate rainfall, the most productive areas within the region may be those on the periphery. In these areas, solar radiation tends to be higher, and disease and pest problems are fewer. Rainfall, however, is somewhat lower and more variable than in the center of the region.

Fortunately, many of these areas have soils and water supplies that are suitable for irrigation. We believe that Mid-Africa can benefit from appropriate programs of irrigation. Small-scale irrigation, in particular, can work to counter variability in rainfall, to provide water at critical times during the planting cycle, and to reduce the risk of applying other purchased inputs. Because this kind of irrigation makes possible a transition to more intensive agricultural systems, the returns to investment can be high.

Development experience in Asia and elsewhere in Africa suggests that privately managed irrigation -- often based on tubewells -- can be extremely successful. This kind of irrigation depends, however, on appropriate public investments in infrastructure; on availability of inputs; on appropriate pricing and marketing policies; and on a broadly favorable social, political, and economic environment.

In addition to full-fledged irrigation efforts, many areas in Mid-Africa can realize substantial increases in production through well-known water conservation measures. These should be promoted more widely.

Fertilizers and Soil Fertility

Many agricultural experts working in Mid-Africa agree on the urgent need for efforts to maintain and improve soil fertility throughout the region. At present, agriculture is deeply constrained by the problem of low and declining soil fertility.

Chemical fertilizers will perform an essential function in increasing production and improving soil fertility. Extensive trials by the United Nations Food and Agriculture Organization, International Fertilizer Development Center, among other agencies, have provided clear evidence that chemical fertilizers produce significant yield responses under most conditions.

At present, chemical fertilizer use in Mid-Africa stands at extremely low levels -- around 5 kg/ha, compared with almost 50 kg/ha in most of Asia. A number of economic factors account for the low level of fertilizer application.

First, transport costs tend to make farmgate prices high for inputs and low for outputs -- thus discouraging the use of fertilizers. Second, government pricing and marketing policies often accentuate the poor price incentives faced by farmers. Third, the subsistence nature of much Mid-African agriculture implies that cash is not readily available for purchased inputs; where population densities are low, farmers will often clear additional land rather than apply fertilizers or other cash inputs. These conditions underscore the importance for soil fertility of investments in infrastructure and marketing, along with policy reform.

In addition, these issues point out the need for additional technologies to complement chemical fertilizer use. In particular, organic soil improvement measures and a variety of erosion controls will help to halt soil degradation and improve fertility. Especially in the highlands of Rwanda, Burundi, Zaire, Uganda and Kenya, soil erosion has increased as a result of rapid population growth. A few measures have succeeded on an experimental basis in slowing erosion; these must be pursued vigorously.

At the same time, experiments indicate that organic fertilizers -- including composts, animal manures, and green manures -- have been highly effective in improving overall soil fertility. According to a number of experts, these materials have the added effect of enhancing the gains from chemical fertilizers.

We believe that considerable potential exists for raising the fertility of soils in Mid-Africa through appropriate investments in research, inputs and infrastructure, to be reinforced by appropriate changes in policy structures. These investments will form an essential component of any plan for Mid-Africa's agricultural development.

Infrastructure and Transportation

Most of Mid-Africa currently suffers from infrastructure and transportation systems that are severely deficient. Poor roads tend to suffocate economic activity by making it unprofitable for farmers to buy inputs or to sell their produce.

In many of Mid-Africa's coastal cities, it costs less to import food grains from Europe and North America than to transport food produced in rural areas of the same countries. Not surprisingly, many Mid-African countries rely on imports -- both commercial and concessional -- for a significant proportion of their food supply. This naturally reduces the markets for domestic agricultural production -- which in turn leads to lower production and greater import needs.

For example, in Tanzania, one report notes that the farmgate price of maize in Rukwa Region is about US$ 8.00 for a 90-kilo bag; the transport cost for bringing this bag to Dar es Salaam is about US$ 13.00.[18] The same report suggests that "as much as one-third of the country's crops may be destroyed annually for lack of rapid transport to consumers," since storage facilities in rural areas are extremely poor.[19]

Similarly, studies indicate that fertilizer prices in the interior of Mid-Africa are driven up dramatically by high transport costs. In Rwanda, the cost of transporting fertilizer from Mombassa (the nearest accessible port) was placed at $173 per ton in 1985. As a result, border prices of fertilizer for Rwanda were probably 250 to 300 percent of prevailing world prices. The added costs of transporting the fertilizer in small quantities to farms in the interior of the country can only be imagined.[20]

We believe that adequate infrastructure and transportation systems are a necessary precondition for agricultural development in Mid-Africa. Although previous attempts to develop both social and physical infrastructure have encountered difficulties, these are problems that must be solved if Africa is to develop. Improved infrastructure would complement investments in irrigation and fertilizer, creating an overall environment conducive to agricultural development.

Government Policies

Despite the importance of agriculture in most national economies in Mid-Africa, many governments have pursued policy agendas that have proven detrimental to the sector. For agriculture to prosper, farmers need to receive adequate price incentives, and governments must make investments that will complement private sector initiatives.

Unfortunately, many Mid-African countries have suffered from inappropriate policy structures during the past two decades, often to the detriment of agricultural production. Domestic policies biased against agriculture, overvalued exchange rates,

cheap food prices, low investment in research and other agricultural activities, and other hinderances to agriculture have been widespread.

It is clear that policy reforms can comprise a significant element of a development strategy for Mid-Africa. But experience with structural adjustment programs to date suggests that policy reforms alone cannot replace selective investment in development. Price liberalizations in Zaire, for example, induced relatively small gains in agricultural output, since much production is for subsistence and relatively little was marketed through official channels.

Another issues is that policy changes in Mid-African countries can have little effect unless they are accompanied by policy changes at an international level, aimed at addressing global imbalances. Distortions in world agricultural markets, caused by farm programs in the United States and Europe, have harmed farmers in Mid-Africa. And the burden of international debt has caused living standards to fall and public investments to cease in several countries.

A concerted effort to address these issues can help Mid-African countries to enhance their prospects for achieving agricultural growth, food security, and other policy goals.

Conclusions -- An Agenda for Action

The countries of Mid-Africa have enormous potential for improving their agricultural production. With appropriate investments, and with favorable global economic conditions, the region could ultimately emerge as a "breadbasket" for Africa.

Some of this growth can be achieved through policy reforms and economic adjustments. These reforms hold a particular attraction because they offer the prospect of growth without expensive investment. (The social costs of structural adjustment are another matter.) In reality, though, agricultural development in Mid-Africa will require heavy investments as well as policy reforms.

We believe that two fundamental concepts can form the basis of a development strategy. The first of these is the notion of major investment in "leading inputs"; the second is the idea of "growth centers."

Of the five **leading inputs** discussed above, three have a direct and immediate impact on agricultural production. These are:

- fertilizers and other measures to improve soil fertility and halt soil erosion

- investment in irrigation systems, particularly those that are small in scale and privately managed, along with water conservation in rainfed areas

- investments in transportation, marketing and storage infrastructure

We believe that these three leading inputs have the potential to generate a strong positive synergism. Irrigation lays the base for fertilizer use, and decreases risk. Fertilizer increases yields. Infrastructure improves returns to farmers and makes investments in inputs profitable.

The focus on these three inputs is not to deny the importance of policy reforms or varietal improvement through agricultural research. Both of these will play an important role in the longer-term development of the region. But much evidence suggests that existing germplasm is adequate for current needs, and new varieties may take many years to reach farmers' fields. Similarly, policy liberalization is an appropriate move in many Mid-African countries, but reforms must be accompanied by investments and inputs.

In short, we believe that aggressive investment in irrigation, fertilizers and infrastructure are the crucial steps needed to encourage farmers to supply more goods to market, while providing them with the necessary technologies to increase their production.

Rather than diffusing these investments widely across the region, we believe that scarce development funds can best be used to focus on specific areas, or **growth centers**. In this approach, specific areas would be selected as initial target zones for intensive development of irrigation, infrastructure, and soil improvement programs.

Selected first would be the easiest areas -- those with good initial endowments of resources, access to markets, reasonable infrastructure, and high irrigation potential. From these "first-order" growth centers, development could spread to secondary centers located at some small distance. The primary and secondary centers would be linked by transportation and communication facilities. In this way, the growth centers would develop symbiotic trade relationships, and trade would stimulate growth in regions between the centers.

Proceeding in this fashion, a growth corridor could ultimately be developed that would cross Africa -- reaching from Nigeria in the west to Kenya in the east. A key component of this corridor might be a transcontinental highway to facilitate movement of goods and people. Although the cost of such a highway might range as high as $1 billion, it could play a catalytic role in stimulating economic growth, intraregional trade, and general commercial activity.

Areas in the northern part of the corridor would primarily be irrigated, while those to the south would develop mainly through improvement of fertility, water conservation, and other inputs to rainfed agriculture. Such a "Mid-African Corridor" might eventually be supported by transcontinental transportation and communication systems, duty-free transit privileges, and reduced tariff barriers. Similar growth corridors might be established later in other areas of Africa.

The details of such a development plan are best devised by those with specific knowledge of conditions in various countries, and with experience in previous efforts around the region. This study is intended only as a first step towards such particularized programs and projects. We believe that there are numerous opportunities for such projects, however, and we believe that the time is ripe for an aggressive program of agricultural development in Mid-Africa.

Footnotes

1 The first of these reports is United Nations Food and Agriculture Organization, African Agriculture: The Next 25 Years (Rome: FAO, 1986). Although the FAO report does not present much detailed agroclimatic data, it makes use of a number of previous FAO studies, such as the organization's extensive soil mapping project. The other reference is to the studies of P. Buringh, H.D.J. van Heemst and G.J. Staring, "Computation of the Absolute Maximum Food Production of the World," a contribution to the research project on Problems of Population Doubling and Food Supply (Wageningen, Netherlands: Agricultural University of Wageningen, Department of Tropical Soil Science, 1975).

2 The most notable omission is that, for purposes of simplification, we have excluded from the study the coastal West African countries to the west of Nigeria. Although these countries share similar agroecological conditions, they face a slightly different set of technical problems. The number of small countries in the region also complicates discussions of policy and national-level issues. We have excluded two mini-states, namely Equatorial Guinea (population 381,000) and Sao Tome & Principe (population 111,000). We expect that many of the technical recommendations for Mid-Africa will have some applicability for coastal West Africa, but we will not discuss these nations directly.

3 World Bank, World Development Report 1988 (Washington, DC: The World Bank), Table 1, pp. 222-223.

4 It is worth noting that the inclusion of Nigeria in the Mid-African region tends to skew the data slightly. Nigeria alone accounts for about 25 percent of the population of sub-Saharan Africa, and about 42 percent of the region's GNP.

5 World Development Report 1988, pp. 222-223.

6 World Development Report 1988, Table 1.

7 These regions correspond roughly to FAO's categories of "humid Central Africa" and "subhumid and mountain East Africa." The regions also follow the general outline of Stephen Carr's draft memo for the World Bank on "A Reference Manual of the Availability and Viability of Technology for Different Ecological Zones in Sub-Saharan Africa" (unpublished photocopy, dated April 28, 1989). Carr refers to the "humid tropics of West and Central Africa" and the "highlands of Eastern and Southern Africa."

8 See FAO and Carr, opera cit. For details on farming systems in the highland regions, see William I. Jones and Roberto Egli, Farming Systems in Africa: The Great Lakes Highlands of Zaire, Rwanda, and Burundi, World Bank Technical Paper Number 27 (Washington, DC: The World Bank, 1984).

9 As noted above, because of the difference between national borders and agroclimatic zones, there are regions within the 11 Mid-African countries that receive considerably less rainfall. Our discussion of "high-potential" regions (for rainfed production) almost definitionally refers to high-rainfall areas, however.

10 FAO, African Agriculture: The Next 25 Years -- Atlas of African Agriculture (Rome: FAO, 1986), p. 47.

11 FAO, African Agriculture: The Next 25 Years -- Annex II: The Land Resource Base (Rome: FAO, 1986), p. 8.

12 Montague Yudelman, Prospects for Agricultural Development in Sub-Saharan Africa, Winrock International Institute for Agricultural Development, Occasional Paper (Morrilton, AR: Winrock International, 1988), p. 5.

13 Ibid.

14 The low level of input use is discussed extensively in Jones and Egli, Op. Cit.; see also, World Bank Staff Appraisal Reports for Rwanda and Burundi Agricultural Services Sector Projects (Reports No. 7557-BU and 7599-RW). The Bank reports are for official use only.

15 FAO, African Agriculture: The Next 25 Years, Annex IV, Irrigation and Water Control (Rome: FAO, 1986), Table 3.

16 FAO has some of the most extensive data on irrigation that can be obtained. See also, Carl K. Eicher and Doyle C. Baker, Research on Agricultural Development in Sub-Saharan Africa, Michigan State University International Development Paper Number 1 (East Lansing, Michigan: MSU Department of Agricultural Economics, 1982), p. 133.

17 Ibid.

18 Goran Hyden, "Agriculture and Development in Africa: The Case of Tanzania," UFSI Field Staff Report 1988-89 No. 5 (Indianapolis: Universities Field Staff International, 1989), pp. 6-7.

19 Ibid.

20 Food and Agriculture Organization of the United Nations, "Fertilizer Marketing Costs and Margins in Developing Countries, 1985/86," a paper prepared for the FAO/FIAC ad hoc Working Party on Fertilizer Marketing and Credit (Rome: FAO/FIAC, 1987).

CHAPTER 3

GERMPLASM TECHNOLOGY AND RESEARCH NEEDS

Introduction

Germplasm technology is ultimately the basis for all agriculture. Whether a crop plant is grown from seeds or propagated from cuttings, the ultimate production level is constrained by the genetic capacity of the plant.

This paper investigates the current status of crop varieties for the major food crops of humid Mid-Africa. No single paper can offer a complete summary of varieties or of biological constraints for all these crops. Neither can a single paper attempt to cover all of the crops grown in an ecologically diverse setting like Mid-Africa.

Research on these crops continues at a rapid pace in most countries; varieties change; new diseases and pests emerge. This paper can do no more than to summarize and evaluate the latest available material, based on the comments and observations of experts in the field and published reports. Some of the observations may be out of date; others may refer to conclusions that are not yet fully tested.

One fact does seem clear: for three of the crops discussed here (maize, cassava, and upland rice), currently available plant varieties appear to be adequate to produce higher yields. Current production levels are well within the physical potential of the varieties that exist in farmers' fields -- and still farther within the potential of the same varieties under experimental conditions.

Disease and pest problems pose numerous challenges, and research needs remain strong. But increases in yields will not, by all evidence, need to await major breakthroughs in crop breeding. Some crops in some zones may be limited by varietal availability, but for Mid-Africa on the whole, germplasm does not appear to be the limiting constraint.

Maize

Maize is the most widely produced grain in Mid-Africa, accounting for a larger proportion of acreage and output than any other cereal crop. Although maize primarily functioned as an export crop during the early colonial period, it has more recently become a staple food in many countries. Thus, Gelaw claims that "although maize is an alien crop of recent origin, it is the most important staple food crop in sub-Saharan Africa."[1]

Gelaw further notes that the relative ease of storage, handling and preparing maize has made it a popular foodstuff among urban populations in Africa as well as among rural peasants.[2] Maize food products consumed in Mid-Africa include: boiled meal; fried meal; boiled ears; baked ears; and a variety of fermented mashes.[3] In addition, roasted ears are served as street food, and a variety of maize breads, porridges and beers are also derived from the grain.

Background

Maize is without doubt the most widely cultivated cereal crop in the humid Mid-Africa region. In many of the countries that fall within the humid agroecological zones, maize is virtually the only cereal grown -- as, for instance, in Kenya, where maize accounts for over 80 percent of acreage devoted to grain crops.[4]

Maize also plays a central role in meeting the region's food requirements. According to FAO estimates (reported in Jahnke et al., 1987), maize accounted for 44.4 percent of daily food energy in Kenya, and 24.5 percent in Tanzania. In Cameroon, 17.9 percent of calories came from maize, and in Nigeria the figure was 6.0 percent. Totals were not reported for other countries in Mid-Africa. Nonetheless, it is worth noting that, as for cassava and virtually any other crop, the national-level aggregates obscure the fact that within almost all of these countries are sub-populations which consume much larger quantities of maize.[5]

Maize tends to be most popular in certain parts of the Mid-Africa zone -- most notably in the moist savannas. Maize is also cultivated under shifting cultivation in the forest areas and on small, intensively farmed plots in the highlands.

The full set of figures on maize area, yield and production for mid-Africa are presented below in Table 1. Both the absolute levels and the variation among countries are worth noting.

Mid-Africa's leading producer of maize is Tanzania, which accounts for the largest single area and production of the crop. Kenya follows in both area and production,

and Nigeria ranks third. Nigeria shows the region's highest yield levels at 2 t/ha, although there is a serious problem with the country's statistical record for maize.[6]

Table 1. Maize area, production, and yield in Mid-Africa, 1987.

Country	Area (1000 ha)	Yield (kg/ha)	Production (1000 mt)
Burundi	135	1222	165
Cameroon	450	844	380
CAR	80	800	64
Congo	11	727	8
Gabon	7	1429	10
Kenya	1600	1188	1900
Nigeria	700	2000	1400
Rwanda	86	1191	102
Tanzania	1948	1211	2359
Uganda	280	1275	357
Zaire	860	903	777
Total	**6157**	**1222**	**7522**

Source: FAO Production Yearbook, 1987.

In general, however, Mid-Africa's yields for maize are extremely low by world standards. As indicated in Tables 2 and 3, Mid-African yields for maize lag far behind the rest of the world -- including those attained in other developing countries, which generally share the problems of tropical climate and soils. Average world corn yields in 1987 were 3,584 kg/ha, a figure about three times as high as the Mid-African average.

Table 2. Global maize production statistics.

Region	Area	Yield	Production
World	127,605	3,584	457,365
Mid-Africa	**6,157**	**1,222**	**7,522**

Source: FAO Production Yearbook, 1987.

The situation in Mid-Africa reflects the continent's overall poor performance in maize productivity. Africa's yield figures have long lagged behind those of other continents, and they compare badly with those in non-African developing countries.

Table 3. Average yields for selected countries, regions, and groups of countries, 1979-81, 1985, 1986 and 1987.

Region	Average Yields			
	1979-81	1985	1986	1987
World	3345	3771	3757	3584
North & Central America	5393	6092	6116	5690
USA	6474	7407	7487	7494
South America	1928	2182	2021	2143
Asia	2296	2628	2729	2788
Europe	4668	5423	6207	6039
Africa	1554	1522	1575	1395
All Developing	1962	2186	2212	2174
Non-African Developing	2093	2403	2416	2414

Source: FAO Yearbook of Production, 1987.

The reasons for Africa's low yields -- and for Mid-Africa's in particular -- are not entirely clear. In large measure, the yield levels probably reflect the extent of mixed cropping in the region. Norman cites research to indicate that 75 percent of Nigeria's maize area consists of intercropping; in Nigeria, an estimate of 84 percent is reported. Often, the intercropping patterns include more than one other crop. Common companion crops for maize in mid-Africa are cassava, rice, sweet potato, and pulses and legumes.[7] Since maize requires fairly good soil nutrient levels, Norman reports that it tends to be grown towards the beginning of multi-year crop cycles in shifting cultivation. It also is found in mixed plantings with perennial tree crops, usually when the trees are in their early growth stages.

Some of the productivity problems in maize can also be blamed on a sub-optimal growing environment. For optimal growth, maize requires plentiful sunlight, warm (but not hot) weather, and dependable soil moisture, particularly at flowering time. Few locations in Mid-Africa -- or in the tropics, for that matter -- can offer suitable combinations of these characteristics.

Along the coastlines, for instance, high humidity tends to keep temperatures from cooling at night, and cloud cover blocks needed sunlight. In the interior, moisture is not always adequate at flowering time. In equatorial areas, 12-hour day lengths limit the availability of sunshine and require longer maturation periods for maize crops.

Because such factors impose serious constraints on maize productivity, Norman et al. conclude that "maize in the tropics has low yield relative to temperate maize, ... partially related to supra-optimal temperature and to inefficient redistribution of dry matter to grain."[8]

Gelaw notes that tropical maize cultivation is more productive at higher elevations and in the "semitropics," away from the equator. These areas, he notes, offer "comparatively cool" temperatures; less cloud cover; longer days in summertime; and lower humidity, which can reduce the incidence of diseases and pest attacks.[9]

These conditions certainly apply to the highlands of Central and East Africa, as well as to the belt of humid and sub-humid tropics that surround the main Mid-African agroclimatic zone. Portions of these more favorable growing environments can be found in virtually all the Mid-African countries, with the possible exception of Gabon and the Congo. In most cases, these are in fact the areas where maize production is now concentrated.

Production Constraints

Maize, like other grains, is a member of the grass family, Gramineae. Unlike wheat or rice, it is not principally a self-pollinated crop. A single male flower, the tassel, grows from the top of the plant and produces the pollen. Female flowers -- the ears -- form along the stalk. This simple physiological fact dictates that maize has a high rate of cross-pollination.

A related result is that maize was (and is) perhaps the easiest grain crop to hybridize. As a result, researchers produced heterosis-seeking hybrids as early as the 1930s in the United States. Yield gains from hybrid corn were dramatic, and in the U.S., hybrid varieties have been widely adapted and commercially produced for several decades. A less desirable consequence of maize's sexual practices is that the crop requires good environmental conditions at the time of flowering. Hiebsch points out that "for proper development of the ear ... each grain in the ear must be fertilized individually by pollen landing on the silks that protrude from the end of the ear."[10]

The greatest problem for maize fertilization, particularly in tropical climates, is that excessively hot and dry weather during flowering can reduce yields sharply. Norman

notes that excessively high temperatures, water deficit, and other environmental stresses can also affect maize growth rates and harvest indexes.[11]

Although maize suffers considerably from lack of adequate water supply, Hiebsch notes that too much moisture and humidity encourage a wide range of diseases and funghi. For this reason, he writes, the crop "is not grown extensively in high rainfall areas."[12] Areas of high rainfall also tend to provide inadequate solar radiation and overly high night temperatures for maize, according to Norman.[13]

Disease and pest problems pose serious problems for maize growers in mid-Africa. Rose reports that for Zimbabwe alone, some 34 maize pests may cause serious losses, with an additional 51 pests causing occasional or light damage.[14] Among the diseases that hamper maize production in Africa, Gelaw lists: leaf spots, corn rusts, ear rots and stalk rots, and maize streak virus. Insect pests include borers, army worms, cutworms, earworms, and several others.[15]

Another biological constraint to maize production is low soil fertility. Both nutrient levels and soil physical structures are poor in much of mid-Africa. Appropriate agronomic practices, such as long fallow periods, can compensate for this problem. Chemical fertilizers and soil conditioners, properly applied, can also provide enormous benefits. Most maize farmers in mid-Africa use very little, if any, chemical fertilizers, at present. This situation must change if yields are to be increased.

Status of Germplasm

Maize (Zea mays) has its botanic origins in Latin America. Although the circumstances of its arrival in sub-Saharan Africa remain unclear, Norman et al. (1984) report that "linguistic evidence suggests that many areas of tropical Africa received maize across the Sahara from introductions to the Mediterranean region."[16]

Although maize has more recently been associated with agriculture in Southern and Eastern Africa, research suggests that the new crop spread first through West Africa, where it was apparently well established by the end of the eighteenth century.[17]

It is worth noting, however, that any discussion of "local varieties" of African maize is a little misleading -- all maize in Africa originated elsewhere, and much of it is of relatively recent origin.

Many "local" lines have mixed extensively with elite materials brought in by breeding programs over the past several decades. CIMMYT and IITA germplasm are widely incorporated into farmers' lines in many countries. Although the local lines may not be "pure" strains of these advanced varieties, they probably represent somewhat advantageous cross-pollinations of the exotic materials with older local lines. Put in a

30-597 - 0 - 90 - 9

favorable light, these varieties represent local adaptations of elite lines, rather than degenerate versions of the same material.

The history of research on maize in Africa is actually quite extensive. Maize was one of the earliest food crops to receive substantial research attention in Africa, perhaps because it was widely grown on large-scale colonial farms as a commercial export crop.

Hybrid maize varieties were released in Zimbabwe (then Southern Rhodesia) in 1949, making that country only the world's second to succeed in developing hybrid maize varieties. Additional research went forward in Kenya, where maize cultivation was also well established at the commercial level. Hybrid varieties were released in Kenya in 1964.

Gelaw notes that the occurrence of tropical corn rust, Puccinia polysora, in West Africa in 1951 prompted additional research on maize. Collections of germplasm were made, and foreign materials were introduced into many countries' breeding programs.

Breeding programs have been active both at the national and international levels. Several national centers have had remarkable success. Kenya and Zimbabwe stand out in particular.

In Zimbabwe, following the release of the hybrid variety SR1 in 1949, researchers went on to produce a series of hybrids with various characteristics. In 1960, the variety SR52 was released. This new hybrid was bred from two locally developed parents, and it immediately skyrocketed in popularity. It was estimated that 85 percent of Zimbabwe's commercial maize area was planted to SR52 in 1985, a full 25 years following its release. Other hybrids -- such as R200 and R201 -- have also been widely grown, and their use has contributed to significant increases in national maize yield levels.[18]

As of 1985, the Zimbabwean program had released 14 double hybrids, 4 three-way hybrids, 6 single hybrids, and 4 modified single hybrids. The earliest hybrids were based on the local open-pollinated lines Southern Cross, Salisbury White, and Hickory King. In recent years, foreign germplasm has been used more heavily, including the U.S. lines B73, MO17, B79, B84, B14, B37, N28H.t, VA26, A632, and others.[19]

Research has been accompanied by a strong program of extension that has promoted fertilizer use (150-40-30/ha), and appropriate plant populations and planting dates.[20] This message has been widely accepted, and smallholder farmers have widely adopted these recommendations, including the use of hybrid seed.

Particularly remarkable has been the extent to which Zimbabwe's hybrids -- notably SR52 -- have been adopted elsewhe in the region. The variety has proved successful in Zambia, Malawi, and even as far away as Cameroon. Jahnke cites Eicher as describing this success as "the green revolution success story of southern Africa."[21] Unfortunately, no statistics are available to show the total spread of SR52 across Sub-Saharan Africa.

Zimbabwe's success with hybrid as been paralleled in Kenya. Kenya's breeding program for maize has rele early 20 varieties of maize since the late 1950s, with virtually all of those being hybrids. In areas with over 700 mm of rainfall, and especially in the highlands, hybrid maize is used almost exclusively. Elsewhere, open-pollinated varieties remain in use.[22] The early hybrids yielded some 30-80 percent above commonly planted materials, and more recent varieties yield still higher by 20 percent. Yields of 12 t/ha have been achieved using the newer hybrids under experimental conditions.[23]

Kenyan breeders began with a variety of local lines, which were merged to form the synthetic Kitale Synthetic II. This open-pollinated variety was followed by the double-cross hybrid 622 and the three-way cross hybrid H632. Crosses of Kitale Synthetic II with foreign germplasm, such as Costa Rica 76 and Ecuador 573, produced the popular hybrid H611. Other varieties widely in use at present include the H612, H613, H614, H511, and H512. New varieties include the Pioneer Seed Company's Hybrid X105A and the high-yielding Hybrid 625.[24]

In other Mid-African countries, hybrids have been relatively less important. In many cases, disease and pest resistance have proven more significant problems, and open-pollinated varieties have shown better adaptation to local conditions.

Many other countries have worked closely with the international agricultural research centers. Among the international centers, both CIMMYT and IITA have worked on maize improvement for Mid-Africa. Both centers have been instrumental in introducing germplasm to Africa that originated in Latin America and elsewhere. Tuxpeño-type materials from Mexico reached breeders in Kenya by the mid 1950s, and such varieties such as Ecuador 573 and Costa Rica 76 were also used in national breeding programs.[25]

Among the successful examples of collaboration between the IARCs and the national centers has been IITA's program to deve rieties with resistance to maize streak virus. This program, which began in 198 , identified sources of resistance and worked with some 36 national programs in Africa to breed varieties which carried that resistance under a wide variety of growing conditions. Resistant varieties also had to be developed to meet a broad range of consumer preferences. This lengthy program

had achieved most of its goals by 1985, showing the value of protracted research on important topics.[26]

CIMMYT has focused on providing open-pollinated maize varieties for Central, Southern, and East Africa. A number of CIMMYT varieties have been released directly or used in national breeding programs to create released varieties. Among the most widely used CIMMYT materials are Tuxpeño 1, Tuxpeño C_{11}, ETO Blanco, La Posta, and Blanco Cristalino-2.[27]

Examples of successful cooperation between IARCs and NARCs include Nigeria, where two populations have been developed by national program breeders in cooperation with IITA. The population TZB consisted of African and Latin American materials, including substantial amounts of Nigerian Composite B. The second population, TZPB, originates from CIMMYT's Tuxpeño Planta Boja Cycle 7. Anderson reports that these populations were released from Nigeria's National Cereals Research Institute as FARZ 27 and FARZ 34. As of 1981, they were reportedly the most widely planted varieties in the country, accounting for perhaps 200,000 hectares. The popularity of these varieties appears to have spread still farther, although the figure of 1 million ha in 1984 (attributed by Anderson to Okoro and Onuoha) seems improbably high.[28]

In Malawi, Anderson reports that CIMMYT researchers have helped to develop two composites, Chitadze Composite A and Chitadze Composite B. Composite B contained about 60 percent CIMMYT materials. A new composite, Chitadze C, incorporates still more CIMMYT germplasm and is apparently adapted better to dry conditions.[29]

In Tanzania, Anderson reports that plant breeders "have used germplasm from CIMMYT and IITA maize populations such as La Posta, Pool 16, TZSR-W and TZSR-Y to obtain streak virus resistant cultvars that have recently been released or are being released.[30] In 1983, the varieties Kilima and Staha were released for intermediate and low-altitude zones, while Kito was recommended for areas below 1300 meters. Other commercial varieties include H6302, which yielded a mean of 9.2 t/ha in high-altitude trials between 1980 and 1984. The varieties H614, H632, and H622 are also recommended in some areas.[31]

In Uganda, maize research has recently been re-invigorated following a number of years of little activity. Political turmoil impeded all research activities and hampered farming throughout the country. A number of observers have stated that current yield levels have no relation to the country's potential, or to the genetic potential of existing varieties. Recent experimental results, however, indicate that extremely high maize yields can be obtained from available varieties, using good management practices. A set of fertilizer trials at Makerere University, using the improved variety Gusau-TZB,

attained yields of 9.9 t/ha, suggesting that the yield potential is excellent. Other reports indicate that the Kenyan open-pollinated variety Katumani is widely grown in Uganda, along with the locally developed composite line Kawanda Composite A. Some Kenyan hybrid varieties such as H622, H632, and H614.[32]

In Cameroon, the NCRE project has shown promising results since the beginning of the 1980s, despite continuing problems with maize streak virus. In 1983 trials, the variety Gusau TZB 81, based on IITA germplasm, yielded 7.5 t/ha; other promising varieties included TZPB, and Poza Rica 7843. More recent reports indicate that the varieties COCA, BACOA, Foumbot MSR, Babungo MSR, CMS 8503, CMS 8501, CMS 8611, CMS 8507, and TZESR are considered significant.[33] According to one researcher, "existing varieties are adequate ... in lowland humid tropics; however, improved maize varieties for high altitude regions are yet to be developed. All these materials have high potential yield under high-input management."[34]

In the Congo, where agriculture is of relatively minor economic importance compared to oil production, maize is grown for animal feed on several large-scale farms. Weeds remain a production constraint, however; and on small farms, the crop cannot be easily dried because of high humidity.[35]

Burundi's research program released the variety Kisozi 41 in 1941; since independence, the varieties Bambu (from Zaire) and GPS5 have been released. All those varieties remain in cultivation, but Igarama-4 is now recommended for altitudes of 1500-2000 meters, and Kitale and Isega are recommended for high-altitude (above 2000M) locations. Recently, the country's breeding program has made increased use of materials from IITA.[36]

Zaire's national program has introduced six varieties since 1971, based on work at Kisanga and other stations. These varieties include Shaba Safi, Salongo, Salongo 2, PNM 1, Kasai 1, and Shaba 1.[38] Of these, Shaba 1 (a cross of Tuxpeño x Eto x Shaba) is currently recommended for high altitudes, with Salongo 2 (Tuxpeño x Eto) and Kasai 1 (selected from Tuxpeño-1, cycle 11) for low altitudes. These varieties are reported to yield an average of 9 t/ha on-station, and 3-5 t/ha in farmers' fields under good management. Current programs in the National Maize Program are focusing on breeding for resistance to streak virus and downy mildew, on developing hybrids for large-scale commercial farmers, and conducting research on a variety of agronomic practices.[39]

Summary of Germplasm Status

Although disease and pest problems remain persistent, the various country reports indicate that adequate maize varieties exist at present in virtually all the countries of

Mid-Africa. In some locations, good hybrid materials are available; in nearly all locations, some improved varieties are available.

Perhaps more important, all the available evidence indicates that "local" and "traditional" varieties have considerable untapped yield potential. The experience of the Sasakawa/Global 2000 projects in Ghana and Zambia (see attached case study) attest to the possibilities for increasing maize yields using existing varieties with fertilizers improved plant spacing, and other techniques.

Numerous areas remain for research, including resistance to Striga, a parasitic weed; resistance to streak virus, lowland rust and blight; resistance to stem borers, ear and stalk rots, and mildews; and other tolerances of different kinds. Pest and disease resistance will remain crucial needs for maize breeders throughout Mid-Africa.

There is no reason to believe, however, that yield improvements will have to wait until new maize varieties are developed. Existing varieties offer the opportunity for higher yields and increased productivity.

In a 1976 working paper for the Rockefeller Foundation, Ralph W. Cummings Jr. wrote that:

> ... maize is the crop where it is most obvious that the development of technology may be running the farthest ahead of the ability and will to apply the technology.... In most cases, farmers are not fully aware of the new technologies. Even when they are aware, shortages of fertilizer and instability of price seriously restrict the use of technology as developed through research; agronomic practices tend to hold yields fairly static. These problems must be overcome before maize yields can be expected to increase rapidly throughout the world.[40]

Cassava

Cassava (genus Manihot) is probably the most important of the root and tuber crops grown widely in tropical Africa. Like sweet potatoes, yams, and taro (also known as cocoyam), cassava is an "underground" crop that produces abundant supplies of starchy food. Perhaps equally important, cassava leaves provide a valuable source of protein and essential nutrients. Cassava was introduced to Africa by the Portugese in the 16th century; since then, it has become a major component of farming systems in the humid areas of the continent.

Importance of Cassava

Cassava stands as the most important food crop for much of Mid-Africa. Consumption levels reach over 100 kg per person per year in some countries; Cock reports that in Zaire and Congo, the average daily consumption of cassava approaches 1 kilogram -- making for annual totals over 300 kg per capita. Cassava probably accounts for over 50 percent of daily caloric intake in those two countries. Other countries where cassava provides over 5 percent of daily caloric intake include Central African Republic, Tanzania, Gabon, Burundi, Nigeria, Rwanda, Cameroon and Kenya.[41]

Furthermore, as Cock points out, even in countries where average consumption of cassava is relatively low, sub-groups of the population often eat far more cassava. Thus, even where the national-level aggregates appear to suggest that cassava is a food crop of little importance, some people may rely on it as the primary source of food energy in their diets.[42]

FAO statistics show that cassava production occupies significant numbers of hectares in all the countries of mid-Africa. Production varies greatly, however, among countries. In Zaire, about one-third of the country's cropped area is devoted to cassava -- nearly three times as much area as for maize, the second most widely planted crop.[43] In other countries, such as Rwanda and Burundi, cassava ranks only fifth or sixth in percentage of cropped area.[44]

At least half of the cassava produced in Africa is grown intercropped, according to research cited by Norman et al. (1984).[45] In East Africa, cropping systems often combine cassava with plantain, maize, beans and sweet potato; in West Africa, cassava is most frequently grown in combination with maize, yams and cocoyams.[46]

National production levels vary from 250,000 metric tons in Gabon to over 15 million mt in Zaire. Zaire is, in fact, one of the world's biggest producers of cassava. The

country has more acreage devoted to cassava production than any other, although its annual production is exceeded by Brazil and Thailand.[47]

Africa as a whole claims some 54 percent of world cassava area, with Zaire alone accounting for 15 percent. Nigeria plants another 9 percent of world cassava area, and other major mid-African producers include Tanzania, Uganda and Cote d'Ivoire. Virtually all of African cassava production is used for human consumption. (In contrast, Thailand exports much of its cassava production to Europe for use as an ingredient in animal feeds.)[48]

Although Africa accounts for well over half of global cassava area, its production constitutes only 42 percent of world totals. Low yield levels characterize cassava production over much of the continent. Africa averages only 61 percent of the aggregate cassava yield for the rest of the world; since 1975, the continent has averaged about 7 tons per hectare, compared with about 12-14 t/ha for South America and Asia.[49]

Even within Africa, cassava yield statistics show a wide range of performance. In Zaire, yields have stayed around 7 t/ha steadily since the early 1960s. Nigeria has a higher level -- around 10 t/ha -- but likewise has shown no significant improvement in 25 years. Tanzania, Rwanda and Burundi all show yield levels around 12 t/ha -- towards the high end for the region. In contrast, Cameroon manages only about 2 t/ha, and Cote d'Ivoire has historically managed only 5-6 t/ha.[50]

Perhaps more significant than the actual yield levels reported from different countries is the fact that yields in Africa have grown quite slowly. Although the data are somewhat difficult to interpret, they suggest that since 1961, African yields have increased, at best, from 6.1 t/ha to about 7.6 t/ha.[51] The slow growth of cassava yield in Africa mirrors a sluggish global performance. Possibly because cassava has not generally received the high input levels that have been devoted to other crops (e.g., HYV rice and wheat), the crop has shown little global yield improvement over the past two decades.

This should not suggest, however, that few advances have been made in cassava technology. Neither should it obscure the fact that some countries -- and regions within countries -- have achieved striking improvements in yield.

Current Status of Varietal Improvement

Over the past two decades, a considerable amount of research has focused on cassava improvement for Mid-Africa. National research systems have worked in effective collaboration with IITA, CIAT, and other international organizations to develop high-yielding and disease-resistant varieties of cassava.

As of 1985, the CGIAR Technical Advisory Committee reported that "twenty-six varieties of cassava related to IITA germplasm have been named and released by six African countries."[52] Elsewhere in its report, the TAC noted that "cassava clones developed at IITA or based on IITA material are currently grown on about 1.5 million ha in twelve African countries."[53] This statistic, if accurate, would suggest that approximately 20 percent of African cassava area is planted to IITA-derived varieties. Unfortunately, no source is given for the estimate, and it is not clear on what information the figure is based.

Anderson (1985) concludes that IITA-based cassava clones "should spread to 5 million ha by the early 1990s."[54] This would represent more than a threefold increase in area under improved varieties, and Anderson places the value of such a gain at "about $9 billion ... every year at current prices."[55]

These aggregate figures are reflected in a strong record of cassava varietal improvement at the national level.

In Nigeria, improved varieties of cassava, distributed by institutions including National Root Crop Research Institute (NCRCI), are grown on 40 percent of the cassava area in Nigeria's southeastern forest zone. These varieties yield 25-30 t/ha, and they have shown resistance to cassava mosaic disease and bacteriosis.[56] Among the most successful of these varieties have been three developed at IITA: TMS 30572, 20255, and 30395. The variety 30572 has shown some resistance to cassava mealybug, whereas U41044 is probably susceptible. (Interestingly, 30572 and 30395 have also performed extremely well in Uganda, attracting attention from researchers there.)[57] Other new varieties in Nigeria include U/8287, U/8203, U/8212, and U/8208, and TMS 30555, 30337, 30001, and 30211.[58]

The importance of these new varieties in Nigeria is illustrated by a set of on-farm trials conducted in 1987 in Bendel State of Nigeria. A group of IITA improved varieties used in the trials showed a mean yield of 19.6 t/ha, compared with 11.2 t/ha for local varieties. No chemical fertilizers were used in the trials.[59]

Zaire's PRONAM project has worked since 1974 to develop improved varieties for cassava, working from a base of research by Belgian scientists and the national research system (INERA). The early variety O2864, released in 1960, proved resistant to bacteriosis, but susceptible to other diseases. In the 1980s, PRONAM has released the high-yielding and disease-resistant varieties Kivuvu (30074/2) and Kinuani (30085/28). These varieties have yield potential of 25-30 t/ha, as compared with 15-20 t/ha for O2864. A World Bank study estimated that wider distribution of

controlled seed materials for these varieties would raise yield levels from 7 t/ha to 11.3 t/ha.[60]

Similarly, in Kenya, the varieties Guzo, 5543/156, Kibandameno, and 46106/27 all performed well in on-station trials at Msabaha Research Center. Over a three-year period, average yields of 25 t/ha were recorded for three different varieties under varying regimes of fertilization. The variety 5543/156 recorded mean yields of 30 t/ha with no applications of fertilizer, suggesting the potential for raising yields through improved agronomic practices.[61] The question remains, of course, whether these practices are applicable to on-farm situations.

In Rwanda, the popular local variety EALA 07 is being replaced by a series of new varieties developed by the Institute of Agronomical Sciences of Rwanda (ISAR) in collaboration with IITA. The new varieties, such as Creolinha, Mulundi, and Kiryumukwe, all produced over 20 t/ha in on-farm trials. Creolinha, in particular, outyielded local varieties, with average yields ranging from 23-39 t/ha on farms in five different regions. Mulundi was also singled out for praise from farmers because of its sweetness and good eating characteristics; in fact, the Mulundi tubers were considered so desirable that many plants were reportedly harvested early to avoid theft.[62]

Tanzania's National Root and Tuber Crops Improvement Program, along with other institutions involved in research, has succeeded in producing a number of useful varieties. In trials at Ukiriguru Agricultural Research Institute, the variety SPN/0 matured in 90 days, tolerated weevil infestations, and yielded about 30 t/ha. Preliminary reports suggested that the variety is also well suited for parts of Malawi, Kenya and Uganda.[63]

Cassava Pests and Pathogens

Diseases and pests have often been cited as the major constraints to increased and stable cassava production. Cassava is susceptible to a broad range of pests and pathogens, which include: cassava mosaic disease, cassava bacterial blight, cassava bacterial necrosis, cassava anthracnose disease, cercospora leaf spots; cassava mealybug, green spider mite, variegated grasshoppers and white flies.[64]

Efforts to counteract cassava's disease and pest problems have followed two complementary approaches. The first has been a strong plant breeding effort to produce varieties with resistance to a broad range of pathogens. The second approach has been to control pests through integrated biological techniques.

Plant Breeding for Resistance to Disease and Pest Problems

Eicher and Baker note that both IITA and CIAT have pursued concerted programs of breeding for "resistance to pests and disease -- particularly mosaic disease and bacterial blight." In addition, they write, researchers have sought to develop "increased yield potential, higher starch and protein content, lower fiber, and ... [the combination of] early maturing with good storing properties."[65]

These efforts have already shown results. IITA plant breeders have produced varieties with demonstrated resistance to a range of pests and diseases, including the seriously damaging cassava mosaic virus.[66]

In addition, plant breeders have attempted to develop varieties that tolerate or resist cassava mealybug and green spider mite. Early results indicate that resistance to both pests is highly correlated to pubescence (leaf hairiness). Pubescence is a highly heritable characteristic, and Hahn notes that "CGM resistance can be utilized by genetically incorporating the pubescence character into high yielding but CGM suceptible varieties or populations."[67] Several promising cassava lines have been identified that have strong pubescence, including TMS 91934. From these, such cultivars as TMS4(2)1425 have been produced, that combine the pubescence trait with other important qualities, such as good yielding ability, low cyanide content, good garification rate, and good cooking qualities for gari and fufu.

Biological Control

Probably the two most important cassava pests in Mid-Africa are the cassava mealybug (CM) (Phenacoiccus manihoti) and cassava green spider mite (CGM) (Mononychellus progressivus and M. tanajoa). Both of these insects are originally native to Latin America. They were introduced to Africa during the 1970s, and quickly developed into serious problems in scattered areas around the region. The two pests now occur in 31 of the 35 countries in Africa's "cassava belt," and they cause yield losses up to 80 percent.[68]

Because of the damages caused by these two insects, scientists have singled them out as targets for an innovative program of biological control. A special center for biological control has been set up in Cotonou, Benin, and since 1980, scientists have introduced 14 species to Africa that are considered natural enemy species for the two pests.[69]

Four of these have become permanently established as enemies of cassava mealybug in Africa. The most dramatic success has been the identification, multiplication and release of a species of wasp, Epidinocarsis lopezi, that is parasitic on cassava mealybugs. This biological control agent has shown remarkable potential

for reducing mealybug infestations. Since mealybugs have become an endemic pest through much of tropical Africa, E. lopezi appears to offer farmers relief from a persistent problem.[70]

Biological controls of this kind are particularly effective for a subsistence crop like cassava in that they do not require farmers to purchase any pesticides or other inputs, or even to provide additional labor. The natural enemies also function independently of extension systems; in general, they constitute a highly economical means of pest control.

Anderson, in his 1985 report for the CGIAR Technical Advisory Committee, identified these biological control measures as an area of "enormous potential payoff for both Africa and parts of Latin America."[71]

These controls probably offer more promise for introduced pests, like CGM and CM, than for other targets. Nonetheless, they can play a crucial role in reducing cassava yield losses and improving overall productivity.

Commercial Opportunities for Cassava Production

Although cassava in Africa has generally been viewed as a subsistence crop, it is worthwhile to note that considerable opportunities may exist for commercial production of the crop under intensive conditions.

In Thailand and Brazil, cassava production is commonly processed into chips for export to Europe, where it is used as an ingredient of animal feeds. In many African countries, cassava plays an important role in local food-processing industries, as it is processed into farina or gari, flour, and other products. Cassava is also used in some kinds of brewing operations, as in Uganda, where it is made into a kind of gin known as waraji.

In northern Uganda, a 200-hectare estate is planted in cassava at the Lira Starch factory. The factory processes cassava into commercial starch, some of which is used locally and the remainder of which is exported to West Germany.[72]

The potential of such enterprises may be considerable. Certainly, they suggest a new focus on cassava and a recognition that it can be a crop with considerable potential for "adding value." Cassava growers need not always produce for subsistence; under appropriate marketing conditions, they can earn significant profits and valuable hard currency.

Evaluation of Germplasm Technologies

In the past two decades, cassava varietal improvement for mid-Africa has made great strides. Collection of genetic materials, screening for disease and pest resistance, breeding, varietal testing and evaluation, and development of new research methods have all contributed to the development of a new cassava technology.

To date, the gains from this technology have been slow and limited. Disease and pest problems remain major constraints to cassava yield increases. Additional location-specific research is clearly required to transfer the new cassava technology to areas that have not yet benefited. Some additional complementary research must continue to focus on national and international measures to combat diseases and pests. Where these problems remain acute, new varieties will probably be slow in improving yields. In general, however, genetic technologies appear to exist that will improve cassava yields over much of the region.

Particularly noteworthy is the fact that these varieties apparently rely little on complementary inputs of fertilizer, irrigation, or even labor. Much of the yield increase they offer is derived simply from increased plant efficiency and from reduction of stresses caused by pathogens and pests. This makes the new germplasm technologies well adapted to the realities of on-farm conditions in the region.

Since the new varieties do not require additional expenditure on capital or on inputs, and since cassava primarily serves as a food crop, poor farmers and consumers should gain from the technology. Lipton and Longhurst conclude, in their excellent study of Modern Varieties, International Agricultural Research, and the Poor (1985) that "high-yielding, mosaic-resistant IITA cassava varieties, as and when they get into farmers' fields on a large scale, must improve self-consumption among the rural poor in Africa."[73] All this suggests that germplasm technologies do currently exist to increase cassava productivity in Mmid-Africa. Although the benefits of these technologies have not as yet reached all the countries of the region, the basic research strategy appears sound.

A number of important directions remain for research in the years ahead. Anderson lists a number of "pipeline" technologies for cassava that could, with appropriate research investments, begin to bear fruit in the next few years. Potential gains from these technologies would appear to be considerable. Anderson lists in this category:

- breeding for tolerance to low soil fertility, root rot, Cercospora leaf spot, superelongation, and anthracnose

- breeding for resistance to thrips, mites, mealybugs, bacteriosis, mycoplasma, root rots and viruses

- breeding for tolerance to high altitude conditions, such as low temperatures, long growing cycle
- development of biological controls for mites, mealybugs, hornworm, root rots
- recommendations for improved practices to prevent root rot, promote soil fertility maintenance, and reduce erosion
- methods to improve the quality and treatment of planting materials, to cut back on disease problems, poor germination, and labor requirements
- recommendations for improved intercropping systems
- improved storage technologies for fresh cassava, new technologies for drying and processing cassava[74]

Upland Rice

Rice (genus Oryza) is the most popular cereal grain in many parts of Mid-Africa. Partly because of its convenience and palatability, rice has grown particularly popular among wealthier consumers in Mid-Africa's urban areas. Much of the region's rice is imported, however, often at considerable cost. Because of the scarcity of irrigated land, domestic rice production is almost entirely upland. Upland rice is a crop with limited production potential, but as long as demand for rice remains high, upland rice production will continue to occupy a major role in Mid-Africa's farming systems.

Background

Upland rice differs from other crops discussed in this paper in that it represents a particular agronomic regime as well as a distinct plant species or subspecies. As defined in a 1982 workshop at Bouake (Cote d'Ivoire), upland rice is a term that applies to rice "grown in rainfed, naturally well drained soils without surface water accumulation, normally without phreatic water supply, and normally not bunded."[75] Upland rice equates more or less exactly to "dryland" rice, and to the French term "pluvial."

Africa as a whole grows about 2.3 million hectares of upland rice, representing roughly 45 percent of the continent's rice-growing area.[76] Within Mid-Africa, Zaire and Nigeria are the major rice producers; both countries produce substantialareas of upland rice. In Zaire, out of 290,000 hectares of rice area, about 260,000 fall into the category of upland rice. More than half of Nigeria's 450,000 hectares of rice are grown under upland conditions.[77]

In general, upland rice is a subsistence crop, although many farmers sell small surpluses on local markets. Most of Mid-Africa's upland rice is grown by poor farmers, often under systems of shifting cultivation and mixed cropping. Farmers plant upland rice both in savannah and forest regions. Yields tend to be low, whether measured on a per-plant basis or a per-area basis; average crop yields probably average slightly under 1 t/ha.

In part, yields of upland rice are low because the crop has inherently low production potential. For example, De Datta notes that rainfall quantities and variability, soil fertility, weed competition, and disease and pest problems all represent severe constraints to upland rice production. Additional problem is that the hardy varieties that can withstand these problems often lack the ability to produce abundantly.[78]

The low inherent productivity of upland rice is reinforced by comparably low use of inputs like fertilizer. Low input use, in turn, reflects the crop's poor productivity as well

as the inherent variability of growing conditions. With uncertain rainfall, fertilizer use loses its attraction.

Nevertheless, upland rice remains an important crop through much of Mid-Africa. Rice is a popular food, and particularly in the growing cities of the region, demand for rice is high. Rice prices generally reflect the strong demand, making rice production profitable even at relatively low levels of productivity. An IITA study notes that rice requires three times as much labor per calorie of output as cassava, but because of price differentials, rice provides a roughly equivalent economic return to labor.[79]

Status of Varietal Improvement

In recent years, research on upland rice in Mid-Africa has involved both national and international institutions. IITA, WARDA, IRRI, IRAT, and others have worked with national research systems to develop improved varieties of upland rice, with mixed results.

Most of these efforts have focused on attempts to develop shorter varieties (100-130 cm), with tolerance to drought stress, resistance to lodging (i.e., will not fall over under conditions of high fertility), and resistance to blast and other diseases.

These efforts have begun to generate results, as new varieties have begun to reach farmers' fields to replace a previous generation of varieties.

These older varieties -- many of them generated in the 1950s and 1960s -- were largely pureline selections from locally grown populations. For example, the Liberian variety LAC 23 was selected from a local variety in 1967-68. Similarly, in Nigeria, the National Cereals Research Institute, located in Ibadan, released the selection FARO 3 (from local strain Agbede 16/56) in 1958; it possessed moderate resistance to blast, and yielded higher than most traditional varieties.[80]

Upland rice breeding also has a long history in Zaire, dating back to work by the Institut National d'Etudes Agronomiques du Congo (now INERA) in the 1930s. INEAC released the popular selection R66, and the affiliated Yangambi Research Station in 1966 released the variety OS6 (also known as FARO 11), which has remained one of the most widespread upland rice varieties in West Africa. OS6 was higher-yielding and more fertilizer responsive than FARO 3, and it displayed similar characteristics of blast resistance.

Twenty-five years later, R66 and OS6, along with the varieties RY1 and R60, remain extremely widespread in Zaire, testifying to the slow pace of varietal improvement in upland rice. Yields average about 700 kg/ha on Zaire's extensive rice plantings in Bandundu, Equateur, Haut-Zaire, and Kivu, according to a World Bank study.

The same study estimated that improved varieties could increase Zaire's average yields for rice from 700 kg/ha to 1 t/ha -- nearly a 50 percent gain. A few such varieties have begun to emerge from the research stage. The Zairian research organization INERA (Institut National pour l'Etude et la Recherche Agronomiques) has identified a number of rice varieties and cultivars that appear promising for various local environments. Among these are RY145, PR6-B-8-1, and PR4-2-1. Other lines, including PR16-2-2, PR10-6-1-3-4-5, PR10-B, and PR23-B have also shown good results in initial trials. Yields for these new varieties appear to range from 1.5-2.5 t/ha, although it is not entirely clear that these higher yields will translate into increased production under farm-level conditions and constraints.

INERA, like most of the national agricultural research services in Mid-Africa, conducts trials that draw on materials supplied by the various international centers. Thus, the International Rice Testing Program (IRTP) provides vast quantities of improved and unimproved germplasm material for screening each year. Through these nurseries, the national centers receive the kinds of raw materials they need for breeding and selection.

Thus, in Nigeria, several cultivars selected from IRRI and IRAT materials have proven to have useful characteristics, including TOx86-1-3-1, TOx356-1-1-1, TOx495-1-1-1, TOx718-1, and TOx718-2.[81] Other successful varieties have included ITA116, ITA117, ITA118, ITA141, ITA162, ITA225, ITA235, and ITA257. Under experimental conditions on research stations, these varieties have yielded as high as 5-6 t/ha -- essentially five times the average for traditional varieties under normal practices.[82] These yield levels, needless to say, have not yet been translated into farm-level production gains.

Researchers in Cameroon have also achieved some preliminary successes in their efforts to identify higher-yielding upland rice varieties. Among the most promising varieties tested on the Mbo Plain in 1984 were IRAT 110, ITA 120, and IRIM 209. IR52, ROK16, and IR2061-522-6-9 also gave good results in a trial of medium-duration varieties. In similar trials on the Ndop Plain, ITA 222, ROK 16, ITA 208, 387-113-C, and IR52 all performed better than the control variety, with yields of 2.5 to 4.7 t/ha. In a preliminary trial, P4023d-Tb-14 posted a yield of 5.7 t/ha, but its long-term yield stability was unclear.

A substantial amount of upland rice breeding has also gone on at Bouake, in Cote d'Ivoire, an area which shares many of the same agroclimatic characteristics as the Mid-African region. In June of 1988, the West African Rice Development Association (WARDA) moved its headquarters to Bouake from Monrovia, Liberia. Bouake was already a major base for IRAT's upland rice program; with the addition of WARDA, it now represents the center of West African upland rice research. Although WARDA's

work is focused on the coastal and Sahelian countries of West Africa, much of its research extends to Mid-Africa.

From 1984 to 1986, the WARDA upland rice program evaluated 655 upland rice cultivars, with 40 selected for use in breeding. One variety, WABIS 675, appeared particularly promising as a potentially high-yielding variety; another variety, WABZI, was advanced to on-farm trials in 1987.[83]

In 1987, WARDA scientists made 35 crosses of upland varieties, and nine crosses were introduced from IRRI. Although it is not yet clear how many of these will produce desirable progeny in the F5 and F6 generations, WARDA's new focus on breeding and crossing promises to accelerate the development of new upland rice varieties for Africa.[84]

WARDA's breeding efforts have been complemented by those at IITA, where a number of promising varieties have been developed and others screened for various characteristics. The varieties ITA 117, ITA 118, and ITA 235 originated at IITA, and the institute has also played a central role in evaluating varieties developed at IRRI, CIAT, and other research centers.

Other breeding efforts have focused on incorporating into upland rice varieties some of the useful characteristics found in wild rice species native to Africa. Although rice is widely considered to be a crop of Asian origin, it is interesting to note that six of the 22 recognized rice species are native to Africa. These include Oryza glaberrima, O. barthii, O. longistaminata, O. punctata, O. eichingeri, and O. brachyantha. In fact, African cultivation of Oryza glaberrima almost certainly pre-dated the introduction of Oryza sativa from Asia; domestication of the two species appears to have been independent. Chang suggests that O. glaberrima probably originated in the Niger River delta around 1500 BC, and it was probably cultivated in Mid-Africa for hundreds of years before the relatively recent introduction of O. sativa.[85]

Other Constraints to Upland Rice Improvement

Although considerable needs remain for improved varieties of upland rice, it is not clear that plant breeding remains the top priority for increasing upland rice production.

In its Strategic Plan, 1990-2000, WARDA notes that the top priority for increasing the productivity of upland rice and inland swamp environments will be:

> Improved soil fertility techniques, involving the incorporation of organic matter and nitrogen fixation and combining the latter withthe use of rock phosphates (for both ecosystems) and with

> the application of commercial NPK fertilizers where appropriate.[86]

This conclusion emerges out of WARDA's assessment that varietal improvement can only offer partial solutions to the problems of upland rice production. The strategic plan notes that:

> under upland/hydromorphic conditions, the most important group of physical and biological constraints are those associated with the stability and sustainability of rice production, mainly water stress, blast, and adverse soil conditions, including low and declining fertility, poor water retention, and erosion. As Herdt and Riely have pointed out, introducing genetic resistance to any one of these problems would probably improve productivity only marginally, since the others would still hold yields down.[87]

Among the other constraints to upland rice production that WARDA notes are weeds, diseases, insects, and birds. With the possible exception of disease resistance, these problems are similarly intractable through plant breeding. Clearly other technologies -- and perhaps other farming systems -- will be needed to resolve the problems of rice production in Mid-Africa. Most fundamentally, irrigation would transfer rice production to more intensive paddy systems, in which inputs of labor, machinery, and fertilizer could give greater returns.

Until these other constraints are removed, varietal improvement efforts in upland rice will prove generally unrewarding. Existing varieties are probably adequate for current conditions, and the potential for new varieties to increase production is almost certainly lower than the potential for increasing yields through fertilizers, water control, and gradual movement towards "lowland" farming systems.

Bananas and Plantain

Throughout the humid tropics of Africa, bananas and plantains constitute a vital component of local food systems. Some 60-70 million people consume plantains and bananas as staple foods, deriving more than 25 percent of their carbohydrate intake from these crops.[88] As with all food crops, there is considerable local variation in the importance of bananas and plantains in people's diets. According to Swennen and Vuylsteke, plantains are the single most important source of calories in south-central and eastern Cameroon, as well as in parts of Gabon, Congo, and Zaire.[89]

Background

All bananas and plantains belong to the genus Musa. Within this family, distinctions are often made between true plantains, cooking bananas, beer bananas, and dessert bananas. These divisions are based on the end use of the fruit, and they are often confused.

The differences, however, are significant. In Africa, the term "plantain" refers to a specific taxonomic group of fruits, identifiable by their genomic formula (AAB genome, resulting from a natural crossing between Musa acuminata, which provided genome A, and Musa balbisiana, which provided genome B).[90]

As Dorosh notes, it is particularly consequential to distinguish true plantains from the other bananas (genome AAA) since "certain cultivars of cooking bananas (but not of plantains) have been found to be resistant to black sigatoka disease."[91] Black Sigatoka disease (Mycospharella fijiensis, var. difformis), is a disease which causes leaf spots and kills plantain leaves. The disease was introduced to Africa relatively recently from Asia, and it has the potential to cause severe destruction to native varieties. It will be discussed in greater detail later in this section.

Generally speaking, plantains are grown most widely in coastal West Africa and in the forest zones of West and Central Africa. Cooking bananas are grown in the humid highlands of Central and East Africa, where they are often mixed with the starchy "beer" bananas. Dessert bananas are grown intensively as a plantation crop for export in a few places, but they comprise a relatively less important component of domestic consumption.[92]

Plantains and cooking bananas are consumed in a variety of forms. At the most basic level, they are often eaten boiled whole, roasted whole, or sliced and fried. Plantains and cooking bananas are often processed into more complicated foods: pounded into fufu; mixed with cassava and pounded into foutou; sliced and fried into chips; dried and ground into flour; and otherwise prepared in a huge range of ways.

Beer bananas are fermented inside their peels for several days, then peeled, pressed, filtered, mixed with grain, and fermented for several days more.[93] The resulting mixture is high in calories, and it probably constitutes an important source of food energy in the highlands of East and Central Africa, where it is widely consumed.

Production

Statistical data on banana and plantain production is even harder to find -- and even less trustworthy -- than data on many other crops. Since much plantain production occurs in mixed cultivation systems, and under subsistence conditions, measurements of area and production are difficult to record. Dorosh notes that this difficulty is compounded by the problems of differentiating effectively among the various types of banana and plantain.[94]

The FAO makes an effort to report production estimates for bananas and plantains, separately. (No effort is made, perhaps wisely, to report area estimates or yields.) Unfortunately, most knowledgeable observers seem to believe that the FAO data have conflated plantain with various kinds of bananas.

Dorosh presents the following "adjusted" estimates for the eleven countries in Mid-Africa:

Table 4. Banana and plantain production in Mid-Africa (in 1,000 tons).

Country	Plantains	Bananas	Total
Burundi	60	1144	1204
Cameroon	994	60	1054
Cent. Af. Repub.	63	79	142
Congo	60	31	91
Gabon	167	8	175
Kenya	245	138	383
Nigeria	1364	0	1364
Rwanda	113	2150	2263
Tanzania	102	1929	2031
Uganda	339	6492	6831
Zaire	1014	765	1779

Source: Paul Dorosh, Economics of Production and Utilization of Plantains in Africa (Ibadan, Nigeria: International Institute of Tropical Agriculture, 1988), Tables 2 and 3, pp. 4-6.

Nigeria, Cameroon, and Zaire emerge as the largest plantain producing countries, while the highland countries of Rwanda, Burundi, Tanzania, and Uganda lead the way in banana production. Dorosh estimates that for the Great Lakes Highland region -- composed of these four countries -- production of beer bananas accounts for over two-thirds of total production of bananas and plantain. True plantains are concentrated in West and Central Africa, with little significant production elsewhere. This fact has considerable importance for efforts to control black sigatoka.[95]

Much of Mid-Africa's production of bananas and plantains takes place on smallholdings, where the plants are often interplanted with a broad range of other food and cash crops. In West Africa, plantains are often planted as shade for cocoa and coffee fields. They are also commonly planted in backyard compound gardens, where they benefit from mulching and composting. Swennen and Vuylsteke note that plantains in these intensive "garden" settings often yield at rates equivalent to 30-50 t/ha, compared with a low of 4-8 t/ha under shifting cultivation.[96]

Although a large portion of plantain and banana production is consumed at a subsistence level, surprising amounts of both commodities find their way into commercial trade -- either fresh, or in the form of processed foods like beer. Estimates by Perrault suggest that over 40 percent of plantain production in Côte d'Ivoire was marketed through commercial channels in 1979; consumption levels of fresh plantain in Abidjan were higher than in the surrounding rural areas.[97]

Plantain represents a "convenience" food in Nigeria, according to Ndubizu and Okafor. Because of the ease of preparation, urban consumers prefer plantain to such foods as cassava, even though it does not store well and cannot be readily processed into such foods as gari.[98]

Similarly, in Uganda, banana cultivation has reportedly been increasing steadily in areas within 30 km from major population centers. Urban demand and preferences for Matooka, or cooking bananas, have played a major factor in this trend. At the same time, macroeconomic policies and trade trends have led to steep price rises for bottled commercial alcoholic beverages. Banana beer has thus become an important substitute.[99]

Similarly, in the highlands of northwest Tanzania, bananas and plantains are the preferred staple food; according to Malima, they account for more than 50 percent of cropped land in the region.[100]

Status of Germplasm

Both plantain and banana have long histories on the African continent. It is a subject for academic debate whether the wild ancestors of edible bananas (Musa acuminata Colla and M. balbisiana Colla) originated in India or in Africa. In either case, there is considerable evidence that edible bananas have been present in Africa since 7,000 - 8,000 BC.[101] Africa today remains the major source of genetic diversity for plantains, and to a lesser extent for starchy cooking and beer bananas. A broad range of varieties and typologies exist. A recent classification for plantain compiled the characteristics of 113 plantain cultivars; only one is not cultivated in Africa.[102]

The diversity of plantain and banana varieties in Mid-Africa is particularly remarkable in view of the fact that plantain is inherently sterile. It is propagated from suckers and cuttings, and few plants form true flowers. This means that genetic diversity has developed through spontaneous somatic mutations, carefully selected over generations by indigenous people.[103]

For plantain, these varieties fall into four categories: French plantain, French Horn, False Horn, and Horn Plantain.[104] Wilson suggests that a comparatively few varieties in each category account for much of the plantain production in West Africa. Under shifting cultivation, he says, the French types tend to be more popular, with "French sombre" and "French clair" particularly widely planted. Under more intensive cultivation, such as typifies compound gardens, the False Horn types appear to be preferred.[105]

Some popular varieties of plantain include: in Nigeria, Mimi Abue, Koko, Obubit ntana, Nyretia Apem, and Obino Lewai (French type), and Banane Corne (False Horn); in Cameroon and Gabon, Essong, Ovang, Zue Ekon, Kama, Muena Liko, Alou Vini, Mekintu, Elat, At, Eak, Alata, Kelong Sise, Innyale, Obel, and Njock-Korn (French and Dwarf French); in Congo, Ambia, M'Bindi, N'Seluka, Afati, and Anzene (French type), and Ebibi, Diby, Owang, Corne (False horn); and in Zaire, Okere, Bosua, Inkeleikumi, Kocha, Ileli, Sogbe, Afati, Wenge, Koko, Boofo, Yumba, Litete, Ituma, Nguku, and Otiti (French type) and Ogoni, Agbaba, and Osoboaso (False Horn).[106] As Wilson points out, of course, these variety names "remain a most troublesome and unclear area, contributing to much confusion, discussion and misunderstanding among researchers."[107] It is difficult to determine whether individual names reflect different plantain varieties, or merely different local terms for the general plant type. More work is clearly needed, however, to develop suitable varietal descriptors and to identify local cultivars.

Yield and Productivity

Most of the evidence suggests that yield levels for banana and plantain depend far more on growing conditions and farming system than on variety or cultivar type. The range of yields recorded for bananas and plantains is remarkable. Depending on the production system, yields range from 2.4 t/ha to 30-50 t/ha.[108]

Key variables in determining yields include: whether the plants are grown in monocropping or in mixed cropping; with or without mulch; varietal selection; degree of water control; and degree of cultivating intensity.

Wilson notes that the most productive systems in terms of yield and plant longevity are the intensive systems that surround homesteads in some areas.

> These are intensively managed small plots in homestead or village compounds. They are usually pure stands except for trees that occupy a higher canopy level. soil fertility is maintained and weed suppressed by refuse and ash from the household. Productivity and crop longevity are high. Contrary to common belief these are not for subsistence only as sometimes over 80 percent of the crop is sold.[109]

These plots commonly produce 30-50 t/ha in year-round cultivation, making them one of the most productive food production systems known. Since these yields are attained by smallholders under existing farm-level conditions, it appears likely that the technologies exist and are available to increase plantain production.

Research at IITA has tended to confirm the observation that mulching contributes to markedly higher yields and plant longevity. In fact, this research suggests that mulches are far more effective than inorganic fertilizers in raising yields. According to one study, "under field conditions, even when inorganic fertilizers are liberally applied, rapid yield decline is often observed from the first ratoon in tropical weathered soils."[110] Over a four-year period, plots which received 40 t/ha/yr of mulch yielded at four times the level of plots which were fertilized with 300 kg N, 250 kg P_2O_5, and 550 kg K_2O per hectare per year.[111] Some evidence does exist, however, showing positive interactions when mulch and inorganic fertilizer are used in combination.

Labor requirements for mulching can be high, however, and scientists have attempted to develop methods of growing mulch <u>in situ</u>, or otherwise reducing the time requirements.

Probably the biggest obstacles to higher productivity for plantains and bananas are disease and pest problems. In addition to Black Sigatoka, these include Banana

Bunchy-Top Virus, banana weevils, and a variety of nematodes, including Meloidogyne sp., Radopholus similis, Pratylenchus brachyurus, Helicotylenchus multicinctus, Hoplolaimus pararobrustus and Heterodera juveniles.[112] Both weevils and nematodes tend to cause root damage, which harms plant productivity and also interferes with plants' anchoring ability. Both sets of pests cause plants to fall over. Damage by both weevils and nematodes appears to be linked to plant root growth, which suggests that there may be some interrelationships with mulching. For example, mulch may stimulate root growth and help plants overcome these pests; mulch may encourage weevil activity by providing shade and moisture; and certain kinds of mulch (e.g., coffee husks) may have insecticidal properties. Clearly, these are issues which require further investigation.[113]

Other evidence suggests that nematode activity may actually be stimulated by tree clearing and burning, such as typifies shifting cultivation. Heat may accelerate nematode egg hatching, and the disturbance of forest ecosystems may provide nematodes with an opportunity to multiply rapidly.[114]

Bunchy Top Virus (BBTV), has been described as "the most important virus infecting bananas."[115] BBTV is an incurable virus affecting leaves and shoots, which is transmitted by the aphid Pentolonia nigronervosa. Some resistant varieties of banana have been identified, but breeding efforts have been hampered by the inherent difficulties of crossing banana and plantain varieties (discussed below). BBTV control measures also suffer from the fact that no formal technique exists for diagnosing the virus; it cannot be identified except by general observation of infected plants. The virus has not been isolated, and no method is available to screen plant materials.[116]

Black Sigatoka

The gravest problem facing plantain production in Mid-Africa at present is posed by the Black Sigatoka disease. Black Sigatoka is a fungus which causes leaves to spot and die. Yield losses commonly range from 30-50 percent, and in some areas of Asia, the disease has reportedly caused commercial banana production to cease entirely.

The fungus causes affected plants to lose most of their leaves by flowering time; plantains are often completely denuded by harvest time, making bunches of fruit unable to mature.[117]

From its origin in the South Pacific, Black Sigatoka struck Africa in the 1970s, reaching Zambia in 1973 and Gabon in 1979. It has subsequently been reported in Congo, Cameroon, and Nigeria, and most scientists assume that it will soon be present throughout Africa's banana-growing belt.[118]

Although Black Sigatoka can be controlled with chemical fungicides, these chemicals are extremely expensive, difficult to obtain, and costly to apply. The chemicals also pose health risks which may be particularly acute since plantains and bananas are often planted close to houses and living areas.[119]

Varietal Improvement

Most scientists agree that the only viable long-term solution is to plant varieties resistant to the fungus. A number of resistant cultivars of banana have been identified to date; unfortunately, no resistant strains of plantain are known to exist. This suggests that the plantain-growing regions of West and Central Africa could be particularly hard-hit by the fungus.

Development of resistant strains is hindered by the problem that all banana and plantain varieties are extremely difficult to cross or hybridize. Plantain, which is a triploid interspecific hybrid, is inherently sterile. Plantains do not produce seeds, which makes it virtually impossible to conduct varietal improvement of plantain through crossing and selection. The same is true for essentially all commonly cultivated banana varieties. On the rare occasions when seeds are produced, they are frequently infertile.

As E. De Langhe, the director of the International Network for the Improvement of Banana and Plantain (INIBAP), notes:

> It follows therefore that none of the usual breeding schemes (pedigree selection, cross fertilisation, recurrent selection, population improvement, etc.) can routinely be applied to the triploid cultivars. This is in contrast to most other crops where cultivars (or landraces, populations, lines) can be crossed or selfed, and new combinations in the created germplasm progressively selected. Breeding schemes for genetic improvement of **Musa** cultivars have been, and will be, original, if not unique, complicated and expensive.[120]

IITA is one of several institutions undertaking extensive research on breeding resistant varieties. At its Onne substation, IITA has a collection of 300 different banana and plantain varieties, including some wild relatives. Accession of new materials has been slowed by the need to screen for Bunchy-Top Virus; this is done by growing new materials in greenhouses in Belgium (a "banana-neutral country"), where infected materials cannot spread to local production.[121] Breeders have had some success in developing female-fertile lines and in obtaining seeds.

Alternatives

Since the breeding process is likely to require many years, scientists have also attempted to identify and distribute resistant "starchy alternatives" to plantain. Cooking bananas, in particular, have been identified as potential substitutes for plantain in West Africa. Several resistant varieties of cooking bananas (genome ABB) have been identified: Fougamou 1, Foulan 4, Gia Hui, and Nzizi. It is not yet clear whether these varieties will be accepted as adequate substitutes by farmers or consumers.[122]

Dorosh, for one, hypothesizes that cooking bananas may not substitute effectively for plantain if Black Sigatoka becomes endemic. He notes that consumers may prefer to substitute cassava, cocoyam, or other crops for plantain unless the cooking bananas retain acceptable cooking and eating properties. He also suggests that unless production levels for cooking bananas are comparable to current plantain yields, prices may increase -- causing consumers to select alternative foods.[123]

It remains unclear to what extent Black Sigatoka will become a problem in Africa. Some people have hypothesized that cooking bananas may be less severely affected than plantains, and that the cooler temperatures of the East African highlands will prevent the fungus from spreading widely. Considerable cause for concern exists, however, and this disease should remain a priority area for research in the years ahead.

Concluding Assessment

Bananas and plantains represent a vital food crop for Mid-Africa. Under most conditions, existing technologies and production methods should be adequate to meet the expanded food needs of the decades ahead. Varieties currently in use would also be adequate for the future, except for the threats posed by newly introduced disease problems. Both Black Sigatoka and Bunchy-Top Virus pose serious threats for Mid-Africa's banana and plantain production.

Research and new varietal development to address these threats is probably more urgent for bananas and plantain than for any other crop in Mid-Africa. Both basic research -- on breeding methodologies -- and applied efforts in plant breeding, varietal screening, and on-farm testing of resistant varieties will be necessary.

This should be a major focus for research organizations in the years ahead. It is encouraging to note that IITA has identified plantain and banana breeding as priorities in its Strategic Plan for 1989-2000.

Millet and Sorghum

Both sorghum and millet represent important cereal grain crops in Mid-Africa, and they are locally of immense importance as staple foods. Both crops are well adapted to dry areas, and they are often grown in the "sub-humid" agroecological band that surrounds the wetter core of Mid-Africa.

The two crops are originally native to Africa, and they are widely believed to have been the most commonly grown cereals on the continent until the introduction of maize. Both crops show excellent adaptation to African growing conditions, and numerous landraces have developed in specific locations and under particular growing conditions. In consequence, Africa constitutes an invaluable center of genetic diversity for both sorghum and millet.

Background

Millet and sorghum together account for about 30 percent of Mid-Africa's total cereal area and about the same proportion of total cereal production. Much of this production is concentrated in the drier parts of the region, particularly in areas with less than 1000 mm of rainfall per year. Millet is grown widely in areas with as little as 250 mm of rainfall per year, while sorghum cultivation is concentrated in the areas with 500-1000 mm.

Sorghum and millet, like other cereal crops, belong to the family Gramineae. Essentially all the cultivated varieties of sorghum fall into the taxonomic classification Sorghum bicolor, subsp. bicolor, following the classification of Snowden, as modified by Harlan and de Wet (described in House, 1985).[124] Among the millets, two species are widely grown in Mid-Africa. Pearl millet, Pennisetum americanum, accounts for the majority of production in the drier parts of the region, while finger millet, Elusine corocana, is the predominant variety in the more humid areas of Kenya, Uganda, Tanzania and Zaire.[125]

Sorghum appears to have originated in southern Ethiopia and the Sudan, and domestication may have occurred in those areas as early as 3000 B.C.[126] This accounts for the broad range of genetic diversity found in the region. Some 32,000 varieties of sorghum are held in the germplasm collection at ICRISAT in India, and a large percentage of these varieties have been collected from African countries.[127]

Pearl millet similarly appears to have originated in Africa, in the Sahelian zone stretching from western Sudan to Senegal.[128] As with sorghum, the region remains a significant source of genetic diversity for both pearl millet and finger millet. In many of the driest areas of the Sahelian zone, pearl millet is the only cereal cultivated. In

areas with high rainfall, however, funghi and disease problems pose severe constraints to millet production.

Among the Mid-African countries, Nigeria stands as by far the largest producer of both sorghum and millet, accounting for over two-thirds of the region's total harvest. The two grains together account for 85 percent of Nigeria's total cereal area and 75 percent of total cereal production. Maize occupyies a distant third place in grain production within Nigeria, the continent's most populous nation.

Other countries where sorghum and millet account for over half of total cereal production are Rwanda, Burundi, and Uganda. In these countries, sorghum is widely consumed both as a thick porridge (ugali) and as an opaque beer (often made with a combination of sorghum and banana).[129] Sorghum varieties with red and brown kernels are generally grown for beer, while the lighter-colored varieties are consumeed directly as food.[130] Pearl millet is also widely consumed in a variety of porridges, fermented mashes, and as beer.

Production

Most of Mid-Africa's sorghum and millet are produced as subsistence crops with minimal inputs and low yields. Generally speaking, yields of the two crops average around 1 t/ha in Mid-Africa -- considerably better than the yields of 300-600 kg/ha achieved in the Sahelian zone, but still far behind the levels of Latin America, China, and North America. In these areas, yields of 2500 to 4000 kg/ha are common for sorghum, with slightly lower levels for millet.[131]

Mid-Africa's productivity levels for sorghum and millet exceed the continent's averages primarily because rainfall is relatively high within the region. Input use remains extremely low, however. Fertilizers are not widely used, except in Nigeria, where Lele et al. report that "more than half of all fertilizer use ... takes place on sorghum, millet, and maize grown in the North."[132] Elsewhere in Mid-Africa, however, fertilizer use on millet and sorghum is probably near zero.[133] An important side note is that much of Mid-Africa's sorghum and millet are grown in mixed cropping systems; they are, in fact, often planted together. Occasionally, they are also intercropped with groundnuts and/or cowpeas.[134]

Other production constraints for sorghum and millet are disease and pest problems, losses to birds, Striga infestations, post-harvest losses, and price/marketing problems.[135] Among the disease and pest problems, downy mildew (caused by Scelerospora graminicola) is an endemic problem in pearl millet almost throughout Africa. Sorghum also suffers from downy millet problems, but faces more pressing challenges from a number of grain molds, including the toxic fungus ergot.

Midges, shoot flies, stem boreres, head bugs, and leaf beetles are all important insect pests for sorghum and millet. In addition, occasional outbreaks of armyworms, grasshoppers and locusts cause severe losses in affected areas. Much work remains for researchers in identifying effective sources of genetic resistance to these pests, and in developing economical approaches to combatting pest outbreaks, through biological controls and integrated pest management.

Current Status of Varietal Improvement

Most of the varieties of millet and sorghum cultivated in Mid-Africa are traditional landrace varieties. These varieties have been developed by farmers over hundreds of years, and they show excellent adaptation to existing growing conditions. They exhibit high photoperiod sensitivity, and in particular, they show good resistance or tolerance to various stresses, including diseases and pests.

For instance, Andrews et al. note that many West African pearl millet varieties exhibit resistance to downy mildew, whereas other varieties appear to be tolerant to the parasitic witchweed, Striga. Genetic adaptations of this kind are accompanied by agronomic techniques that have evolved to combat other stresses. In many locations, crop planting dates reflect local responses to rainfall patterns; harvest dates are often adjusted to avoid excessive bird damage.[136]

One outstanding feature of most of the millet and sorghum varieties grown in Mid-Africa is their surprising height. In contrast to dwarf varieties and short hybrids that are widely cultivated in the U.S. and other countries, most of the sorghum varieties grown in Mid-Africa are extremely tall. This makes them susceptible to lodging under heavy fertilizer applications (although responses to fertilizer are good at lower levels).

But tall varieties apparently represent adaptation both to economic demand and to growing stresses. In many places, consumers demand sorghum and millet stalks as building materials, fodder, or firewood. and in general, tall varieties apparently compete well with weeds and survive damage from pests and diseases.[137]

Unfortunately, however, tall varieties produce much of their biomass in the form of vegetative matter, rather than grain yields. Andrews et al. note that "while the biomass production of these varieties under the prevailing circumstances is very high, the harvest index is often below 20% as compared to over 40% of improved high yield potential varieties."[138]

Efforts at varietal improvement in sorghum and millet date back 30 years in several countries in Africa, with emphasis on developing shorter varieties with improved resistance to adverse growing conditions and to pathogens. Particularly strong

programs have been in place in Nigeria, Kenya, Uganda, Tanzania and Zimbabwe, as well as in the Sudan, Ethiopia, and Niger, among other countries.

Research has pursued two general approaches. The first has been to seek to improve existing landraces through selection and limited pooling of germplasm. Andrews et al. write that this approach has rarely produced cultivars that yield much more than 15 percent above existing varieties. Examples cited by the authors include Souna III millet in Senegal, and Farafara BL 3-1-6 and SK 5912 sorghum in Nigeria.[139]

The second approach has been to develop crosses and hybrids that mix genetic materials more dramatically. Much of the earliest work along these lines attempted to draw on previous research in the U.S. and Asia. Hybrid dwarf sorghums have been grown in the U.S. for more than 50 years, but the varietal technology has proved extremely difficult to transfer to the tropics. Even the previous work undertaken in the semi-arid tropics of India has turned out to have limited applicability in Africa.[140]

ICRISAT, which holds the mandate to spearhead international research on crops for the semi-arid tropics, moved in the early 1980s to transfer its African efforts to a Sahelian Center in Niger. Breeding work for Africa is now undertaken at the Sahelian Center and increased cooperation with national programs has been initiated.

To date, a number of promising varieties have been developed through national programs and international research. In Niger, the sorghum variety CE 90 and the millet 3/4 HK have proven extremely well adapted. Nigeria's program has produced the successful sorghum variety 189, while Senegalese researchers have developed IBV 8001.[141]

In Cameroon, the sorghum varieties S-34, S-35, CS 54, CS 94, and others are reported to be well-adapted to local needs.[142] S-34 and S-35 were selected originally by an ICRISAT breeder working in Nigeria, and yielded some 70-80 percent higher than local varieties in early trials in Cameroon.[143]

In Nigeria, the brown-seeded sorghum variety Framida has shown good resistance to striga, yielding considerably better than local varieties in areas where the weed is prevelant. Framida has also been used as a breeding line to produce white-seeded varieties, like ICSV 1002 HV, that have shown promise in Nigeria and Cameroon.

Outside the Mid-Africa region, researchers have achieved considerable success with varieties like Melkamesh and Kebomesh in Ethiopia, and the hybrid Hageen Durra No. 1 in the Sudan. Production test plots for sorghum in the Sudan, planted through the Sasakawa Global 2000 Project, have shown that Hageen Dura, fertilized with nitrogen and phosphorus, yielded generally two to four times the level of existing varieties.

Hageen Dura is the product of research by ICRISAT and the Sudanese Agricultural Research Corporation, using a Texas A&M line as the female parent.[144]

Similarly, Global 2000 management training plots in Zambia in 1987-88 showed that even under relatively poor growing conditions, available improved lines -- WSH 287, WSV 187 and WSV 387 -- yielded more than twice as much as traditional local varieties with moderate doses of fertilizer.[145]

Research on millet has progressed less dramatically, but promising varieties with multiple disease resistance have also begun to be identified -- including pearl millet varieties INMB 12 and INMB 70 from the ICRISAT/Nigerian program, and IBV 8001 and IBV8004 from ICRISAT trials in Senegal.[146] In Cameroon, researchers have reported that local millet varieties "are as good as improved germplasm under similar management conditions."[147]

Perhaps the most successful breeding program for pearl millet has been that at Serere, Uganda. Although statistical data are difficult to find, varieties from Serere appear to be widely grown in Uganda, and have also been released and cultivated in Kenya, Tanzania, Sudan, and Botswanda.[148] The Ugandan program has also released improved landrace varieties of finger millet, including the variety P224. Another finger millet variety to be released is the Kenyan line EK-1.

Other Opportunities for Increasing Production

The good performances of local varieties under improved management conditions suggests that plant breeding is not the only solution, particularly in the short run, to increasing productivity of sorghum and millet in Mid-Africa. Although plant breeding and other varietal improvement activities will continue to play an important role, existing varieties appear to have considerable potential for yielding at higher levels. Due in part to the genetic diversity of sorghum and millet varieties cultivated in the region, traditional landrace varieties are often highly productive under good conditions.

Fertilizer use, in particular, can achieve sharp increases in sorghum and millet yields, provided that moisture is adequate -- as is the case in most of Mid-Africa. FAO studies show that appropriate applications of NPK fertilizers in Mid-African countries produce yield responses on the order of 5:1 to 14:1.[149] Another source notes that studies at ICRISAT's Sahelian Center on millet "demonstrate spectacular responses to phosphate fertilization," albeit on different soils from those generally found in Mid-Africa.[150]

Eicher and Baker note that in most of Africa, yields of local sorghum varieties can be raised "several times" using improved husbandry practices. In Nigeria, they note,

"long season improved local varieties have yielded from 2,000 to 4,000 kgs."[151] In a similar vein, Andrews et al. (1984) conclude that existing varietal technology for both sorghum and millet is adequate in most of the appropriate agroecological zones of Sub-Saharan Africa. They write that:

> Improved varieties are but one of the factors which contribute to increased production. There are other factors which are only partly, even minimally dependent, on new varieties, which can be employed today, to increase production, such as fertilizers, pesticides, and cultivation equipment, as well as institutionally controlled supply demand factors.... Production in African countries can be increased with existing technology and does not have to wait for new varieties.... The present low average yield levels of both sorghum and millet could be raised 3 to 4 fold with improved technology. (Emphasis in the original.)[152]

Clearly there is a continuing need for research on sorghum and millet for Mid-Africa. In particular, researchers will need to address issues of disease and pest resistance, stress tolerance, and to some extent yield potential. But new varieties may take many years to develop; in the meantime, there is considerable potential from existing varieties.

30-597 - 0 - 90 - 10

Table 5. Mid-African sorghum and millet production, 1988.

	Sorghum area ('000 ha)	Sorghum production ('000 mt)	Millet area ('000 ha)	Millet production ('000 mt)
Burundi	190	251	66	63
Cameroon	--	--	470	410
Cent. Af. Rep.	--	--	60	50
Congo, PR	--	--	--	--
Gabon	--	--	--	--
Kenya	160	120	60	60
Nigeria	4500	4940	3900	4000
Rwanda	170	177	2	2
Tanzania	514	420	300	280
Uganda	199	289	300	414
Zaire	66	60	42	30
Total	**5799**	**6257**	**5200**	**5309**

Source: Food and Agriculture Organization of the United Nations, Production Yearbook 1988 (Rome: FAO, 1989), pp. 130-33.

Table 6. Mid-African millet and sorghum area and production as percentage of total cereal area and production, 1988.

	Millet and sorghum area as percentage of total cereal area	Millet and sorghum production as percentage of total cereal production
Burundi	60.8	59.9
Cameroon	49.8	44.8
Cent. Af. Rep.	39.7	39.7
Congo	0.0	0.0
Gabon	0.0	0.0
Kenya	10.2	5.7
Nigeria	85.0	74.7
Rwanda	66.2	64.2
Tanzania	27.6	18.7
Uganda	60.4	66.1
Zaire	8.0	7.8
Total	**30.6**	**27.2**

Source: Food and Agriculture Organization of the United Nations, Production Yearbook 1988 (Rome: FAO, 1989), pp. 113, 130-33.

Export Cash Crops

A broad range of export cash crops is cultivated in Mid-Africa. These include both annual crops and perennial plants, field crops and tree crops. This paper cannot claim to provide a detailed account of export cash crop cultivation or production in Mid-Africa. Nonetheless, it is worth considering briefly what options exist for export cash crop production and to what extent varietal technology is currently available.

Background

Definitions of "export cash crops" are not always clear. Almost all crops are produced as "cash crops" in almost every country. And most countries export a number of crops that are also widely grown as subsistence crops. For instance, Kenya is a major exporter of maize; but the grain is also a major domestic food staple.

Some studies refer to the "export cash crops" as "plantation" or "estate" crops, on the assumption that most of the production takes place on large farms or estates. In many cases, however, this assumption is not valid. Poor farmers and smallholders produce considerable quantities of "export cash crops."

For the purposes of discussion here, we will consider "export cash crops" as those crops which are produced entirely for export (or nearly so), and which are consumed at the subsistence level only minimally.

The specific crops that we will consider for the Mid-Africa region are cotton and coffee. Other export cash crops of significance in the region -- at least for some countries -- include cocoa, tea, rubber, oil palm, and coconuts. Bananas are also cultivated in some places as an export cash crop, but they have been discussed previously in this paper.

Cotton

Cotton represents an important cash crop in Tanzania, Cameroon, Nigeria and Zaire, with some significant additional production in Kenya, Uganda and the Central African Republic.[153] The crop was introduced to most of the region during the colonial period, and was primarily produced for export to Europe.

The botanical history of cotton is somewhat unclear. Cotton appears to have been cultivated in Latin America as early as 3500 B.C., but the plant also appears to have a long history in both tropical Africa and in Indo-China. This complex history is reflected today in the fact that a number of different species of the genus Gossypium are

cultivated for their fibers, including G. hirsutum, G. barbadense, G. arboreum, and G. herbaceum.[154]

Much of Africa's production of cotton takes place on relatively small farms, often under conditions of low intensity. In Cameroon, for example, most cotton is grown on small holdings of under 10 hectares.[155] Average cotton area planted per farm is probably under 1 hectare in virtually all of the Mid-African countries.

Lele et al. (1989) point out that francophone and anglophone countries have had markedly different experiences with cotton production. In francophone countries, production tends to be somewhat more intensive and yields higher. Anglophone countries, in contrast "are characterized by a low input/low yield technology" for cotton.[156] The authors claim that yields in francophone countries are "three to four times higher" than in anglophone countries.[157] During the past 25 years, cotton output in francophone Africa has grown by 740 percent -- whereas in contrast, anglophone countries have improved their production modestly, if at all.[158]

Table 7. Cotton production in Mid-Africa, 1988.

Country	Production ('000 MT)
Burundi	3
Cameroon	47
Cent. Af. Repub.	8
Congo	--
Gabon	--
Kenya	8
Nigeria	57
Rwanda	--
Tanzania	82
Uganda	6
Zaire	26

Source: FAO, Production Yearbook 1988 (Rome: FAO, 1989), p. 237.

They attribute this difference to the success of francophone countries in encouraging intensive production of cotton and use of advanced technologies. In many of the francophone cotton producers -- such as Cameroon -- cotton yields are bolstered by

use of fertilizers, pesticides, and mechanization. Cameroon has consequently increased its cotton yields from 532 kg/ha in 1960/61 to 1298 kg/ha in 1987/88.[159]

In contrast, Tanzania typifies many of the anglophone cotton producers in its yield performance. Cotton yields in Tanzania have fallen from 800-1000 kg/ha in the 1960s to about 400 kg/ha in the 1980s. Increasingly, cotton production has been displaced by food production -- particularly as food prices have increased relative to cotton prices.[160]

In large part, the differences in production performance between francophone and anglophone countries reflect variations in pricing and institutional structures. In francophone countries, cotton production tends to be highly structured through government corporations that supply inputs and market output. Most of these corporations work closely with the Compagnie Française pour le Développement des Fibres Textiles (CFDT), which has provided technical assistance, credit, and marketing outlets for national cotton corporations (like SODECOTON in Cameroon).

Perhaps the most notable achievement of CFDT and the various cotton parastatals has been to create an effective system of technological extension, marketing and distribution for cotton growers in francophone Africa. Cotton growers have been provided with technical packages that work, and they have been provided the fertilizer, pesticide, credit, and other inputs that have allowed them to increase their productivity.

This system has been supported by an effective research institution -- the Institut de Recherche du Coton et des Textiles Exotiques (IRCT). IRCT has successfully carried out research on both upstream and downstream topics relating to cotton production, with activities in virtually all the francophone countries. Much of the region's research on cotton is carried on through IRCT's activities.[161]

Among IRCT's activities in Mid-Africa are programs in Cameroon and the Central African Republic. In Cameroon, researchers have worked with the national agricultural research system to develop new varieties, improve pest management techniques, and identify varieties suitable for low-rainfall areas. In the Central African Republic, IRCT has helped to develop the most widely used varieties (as of 1985-86), SR 1-F4 and BJA-B2. The newly-developed IRMA 96-97 was considered extremely promising.[162]

The success of the francophone countries in increasing yield levels for cotton suggests strongly that the constraints to production are not simply technical. While the CFDT system has been widely criticized for encouraging agronomic practices which are neither environmentally sustainable nor economically sound (in an era of falling cotton prices), the francophone experience indicates that technologies exist at present to raise yield levels for cotton within the Mid-Africa region.

Considerable needs remain for agricultural research on cotton, however. In particular, researchers must identify new approaches to plant protection. Experience in the

United States and elsewhere has indicated that pesticide use on cotton has declining effectiveness over time. Biological controls must be developed to deal with such pests as Heliothis, Cryptophlebia, Diparopsis, Earias, Sylepta, and others Such work has already begun, and some promising directions have been identified. For instance, Trichogramma and Tachnidae parasites have been identified for several pest species; and a variety of fungi, bacteria, and viruses have also been investigated for their plant protection potential.

This work will take several years at least to bring practical field-level approaches. In the meantime, cotton growers can work with existing populations of beneficial insects, and with limited use of pesticides, to protect plants. The technologies at their disposal are not ideal, but are adequate for current needs. Agricultural technologies are not the governing constraints in Mid-Africa's cotton production.

Coffee

In a number of Mid-Africa's countries, coffee ranks among the most valuable crops and leading agricultural commodities. Africa as a whole produces about one third of ıe world's coffee, and exports about 20 percent of the world's volume of trade in green and roasted coffee.[163] In 1987, exports of coffee earned Africa nearly $2 billion; the previous year, the total was over $3 billion.[164]

Within Mid-Africa, the largest producers of coffee are Cameroon, Zaire, Uganda, Kenya and Tanzania; all the other countries in the region produce varying amounts. In virtually all the countries of the region, coffee ranks among the leading agricultural exports; in many, coffee exports represent a major source of foreign exchange earnings.

Table 8. Coffee production and exports in Mid-Africa, 1987/88.

Country	Coffee Production (1000 MT)	Coffee Exports (US$mil)	Total Ag. Exports (US$mil)	Total Exports (US$mil)
Burundi	33	58.1	72	84
Cameroon	138	129.3	452	806
Cent. Af. Rep.	22	17.3	40	131
Congo	2	2.1	15	673
Gabon	2	1.4	9	1,271
Kenya	125	237.4	656	960
Nigeria	5	0.9	229	7,365
Rwanda	42	92.0	110	112
Tanzania	51	136.0	297	298
Uganda	184	302.3	312	312
Zaire	97	173.0	219	970
Totals	**701**	**1,149.8**	**2,411**	**12,982**

* Estimated from previous years' ratios.
Source:FAO Production Yearbook 1988 and Trade Yearbook 1987.

From these figures, it is evident that coffee represents perhaps the most important single export crop for Mid-Africa. In fact, coffee may represent the region's second most important export commodity -- after oil, which provides much of the earnings for Nigeria, Gabon, and the Congo.

Coffee falls into the species Coffea arabica, C. canephora, and C. liberica. C. Canephora is often referred to as "robusta" coffee, and a distinction is commonly made between robusta coffees and the arabica. The two types are adapted to distinct ecosystems and have different markets. In general, robusta coffees tend to yield at much higher levels than arabica plants, but the arabica fetch a price premium on world markets.

Generally speaking, arabica coffee is best suited to highland sites with relatively cooler temperatures. Robustas are grown in humid lowland areas, and are tolerant of high temperatures. Both types of coffee prefer rainfall of 1500-3000 mm per year, with a minimum requirement of 1000 mm.[165]

Within Mid-Africa, arabicas are grown in the highlands of Cameroon and in Kenya, Tanzania, Zaire, Rwanda and Burundi. Generally speaking, elsewhere in the region, robustas are cultivated Some liberica plants are also grown in the high rainfall zones of Nigeria, Zaire, and other countries.

Coffee is largely grown as a smallholder crop throughout Mid-Africa. Often it serves as an important cash crop within farming systems. Sales of coffee enable farmers to purchase inputs for their food production, and to enter the cash economy.

In general, few inputs are used on coffee grown on smallholdings. Despite research indicating the effectiveness of fertilizer in improving yields, relatively little fertilizer is actually used. For the most part, this reflects the lack of resources available to farmers. Where farmers can afford any fertilizers, they are likely to use them on coffee plants. Data from Tanzania suggest that coffee and tea together accounted for more than one fourth of total fertilizer use.[166]

As a consequence of the low input use, coffee yields in Mid-Africa tend to be fairly low -- although exact calculations are necessarily ambiguous because of the fact that coffee is often intercropped with food crops and other tree crops. Official figures from Cameroon put yields for arabica around 200 kg/ha, and for robusta at around 500-800 kg/ha. A number of studies suggest that intensive production techniques can easily boost yields to 1200 kg/ha for robusta.[167] In Côte d'Ivoire, in fact, coffee yields of 2.4 t/ha have been reported for nine new clones currently available for distribution.[168]

Among the major production problems encountered in Mid-Africa are coffee rust (caused by the fungus Hemileia vastatrix) and coffee berry disease (CBD, caused by the fungus Colletotrichum coffeanum). Other diseases include leaf spot; pests include green scale, leaf miners, borers, and others.[169]

The focus of much of the research on coffee in various Mid-African countries has been on the possibility of breeding disease-resistant varieties.

In Kenya, breeders have developed mixed populations of coffee plants --called Ruiru 11 -- that grow in a compact fashion and exhibit broad resistance to coffee rust and coffee berry disease. These populations are based on varieties such as SL28, Caturra, Pandang, Rume Sudan, and Hibrido de Timor.[170] As of 1985-86, Kenyan breeders were attempting to generate enough seedlings of these varieties to meet demand. Kenyan breeders also were attempting to develop hybrids between robusta and arabica types (the so-called "arabusta").[171]

Elsewhere, most researchers appear to agree that coffee production in Mid-Africa suffers more from aging trees, lack of pruning and weeding, and limited maintenance than from any inherent genetic deficiencies in the coffee varieties themselves. A study

of agronomic constraints to coffee production in Uganda, for instance, listed as major problems the lack of tools; scarcity of labor; old trees; susceptibility of existing varieties to diseases and pests; shortage of chemicals for disease and pest control; and declining soil fertility.[172] The need for disease-resistant varieties is only one of a number of constraints on yields, and at least in the short run, it does not appear to be the primary constraint.

Livestock

This paper cannot begin to discuss the sphere of livestock production in any authoritative or systematic fashion. Livestock play a crucial and complex role in the farming systems of Mid-Africa, with ruminants an especially critical element of the total system.

Background

Livestock population estimates are inevitably subject to error, but they remain useful gauges of livestock numbers and relative importance of different species. The figures shown in Table 9, taken from FAO estimates, indicate that the eleven countries of Mid-Africa support a population of more than 100 million cattle, sheep, goats and pigs.

Table 9. Mid-African livestock populations, 1988.

Country	Cattle (1000 head)	Sheep (1000 head)	Goats (1000 head)	Pigs (1000 head)
Burundi	340	350	750	80
Cameroon	4,471	2,897	2,906	1,237
C.A.R.	2,313	120	1,159	382
Congo	70	64	186	48
Gabon	9	84	63	154
Kenya	9,800	7,300	8,500	102
Nigeria	12,200	13,200	26,000	1,300
Rwanda	660	360	1,200	92
Tanzania	13,500	4,700	6,600	184
Uganda	3,910	1,740	2,800	440
Zaire	1,400	880	3,040	800
Totals	**48,673**	**31,695**	**53,204**	**4,819**

Source: Food and Agriculture Organization of the United Nations, Production Yearbook 1988 (Rome: FAO, 1989).

Goats are the single most abundant variety of livestock, followed closely by cattle. Significant numbers of sheep also are found in Mid-Africa, but traditional preferences and African swine fever have limited pig numbers. Livestock experts often speak of overall "tropical livestock units," which are weighted totals of livestock populations that reflect differences in weight between livestock species. Jahnke et al. define a tropical livestock unit (TLU) as the equivalent of "an animal of 250 kg liveweight." With appropriate adjustment, Mid-Africa's livestock population is about 43.5 million TLU.[173]

Tanzania, Nigeria and Kenya have the largest livestock populations; but other countries show high numbers of livestock in proportion to their human populations. The Central African Republic, for example, has nearly one cow per person, with an overall average of two animals per human.

Mid-Africa overall has 0.27 cattle per caput and 0.47 sheep and goats per caput. These levels are considerably higher than those in other developing countries and roughly on a par with developed countries. By comparison, the developed countries average 0.35 and 0.47 for cattle and small ruminants respectively; other developing countries average 0.23 and 0.28.[174]

Figures for national TLU totals and per caput averages are shown in Table 10. These figures indicate the range of variation within Mid-Africa, between the Central African Republic and Congo, Gabon and Zaire. The high levels of livestock in the Central African Republic are believed to reflect the movement of pastoralists from the Sahel into more humid savannahs following the droughts of the 1970s and 1980s.[175] Other countries with high per caput TLU totals -- such as Tanzania and Kenya -- have long traditions of herding and livestock rearing.

Comparisons with other parts of the world suggest that the oft-cited scarcity of livestock in Mid-Africa is more accurately a relative phenomenon. Mid-Africa's per caput TLU is only slightly lower than that for Africa as a whole, and it is roughly on a par with world averages. The region has fewer livestock per person than the developed countries, but more than the remainder of the developing world.

Perhaps the perception of low livestock populations in Mid-Africa reflects the low numbers per unit of total land area (as is true also for the human population). Or perhaps it reflects the relatively low productivity of livestock within the region. But livestock are widely present, and they play an important role in Mid-Africa's food system and farming systems.

Table 10. Mid-African tropical livestock units, 1988.

Country	Population (millions)	TLU Total (1000)	TLU Per Capita
Burundi	4.8	364	0.08
Cameroon	10.5	3,957	0.38
Cent. Af. Rep.	2.7	1,824	0.68
Congo	2.0	84	0.04
Gabon	1.0	51	0.05
Kenya	21.2	8,460	0.40
Nigeria	103.1	12,720	0.12
Rwanda	6.2	636	0.10
Tanzania	23.0	10,617	0.46
Uganda	15.2	3,279	0.22
Zaire	31.7	1,532	0.05
Total	**179.0**	**43,524**	**0.24**
All Africa	**609.9**	**166,103**	**0.27**
World	**5,114.8**	**1,218,510**	**0.24**
U.S.	**246.1**	**79,107**	**0.32**
Developed	**1,235.3**	**409,140**	**0.33**
Developing	**3,879.5**	**809,369**	**0.21**

Note: All figures based on populations of cattle, goats, sheep and pigs. These calculations exclude horses, asses, mules, camels, buffaloes, and other animals which are of little importance in Mid-Africa but have considerable importance elsewhere in the world.

Source: Food and Agriculture Organization of the United Nations, Production Yearbook 1988 (Rome: FAO, 1989).

Role of Livestock in Farming Systems

Virtually all of Mid-Africa's livestock are produced in what could be referred to as "traditional" farming systems, as opposed to commercial ranches or feedlots. Much of the livestock production -- and most of the cattle production -- is concentrated in the drier fringes of Mid-Africa, such as northern Nigeria or western Kenya. The highlands of Kenya, Uganda, Zaire, Tanzania, Rwanda and Burundi are also areas of concentrated livestock production. Trypanotolerant small ruminants are particularly widespread in the forest zone.

In part, this distribution is related to the prevalence of trypanosomiasis within Mid-Africa. This disease, spread by tsetse flies, has constrained both the overall populations of livestock in Mid-Africa and the levels of productivity of existing livestock. Total livestock populations may be reduced by 50 percent or more because of disease problems. In addition, outputs of meat, milk, and power per animal remain low due to the disease itself and the diminished productivity associated with tolerant animals.

Generally speaking, livestock in the drier areas tend to be herded or to roam away from the farm on open rangeland or pasture. In the highlands, animals may be kept in enclosed fields near houses. With growing population pressure in the highlands, some animals may be stall-fed with crop residues and other available plant material.[176]

Livestock serve a number of functions in Mid-African farming systems. In some places, they provide draft power to assist timely cultivation, and they can simultaneously convert crop byproducts and residues to high-quality protein. Often, livestock products are the highest-value "cash crops" that farmers can produce. In the Kenya highlands, for example, the income generated from small-scale dairy operations provides cash for purchasing fertilizer and other crop-enhancing inputs.

A useful typology of livestock functions and management is presented by Jahnke et al., among others:

> Output function: Livestock produce food and non-food materials, mainly hides, skins and wool and provide transport services. The surplus of products not used for subsistence is easy to market and enters the monetary economy.
>
> Input function: Livestock provide intermediate products such as animal traction for agricultural field work, transportation or other purposes; and manure used as fertilizer, organic materials or fuel. Livestock also convert crop residues and fibre materials of no value into protein of high quality.

> Asset and security functions: Livestock have the characteristics of a capital investment yielding an interest in the form of milk, eggs, etc. They are a safe and durable form of storing and increasing wealth, especially if there is no financial system to ensure this function.
>
> Social and cultural function: Livestock are involved in social exchange within families or with other social groups. Slaughtering for traditional feasts or religious ceremonies gives social rewards for the cattle owners and reinforces family and social links. Livestock have a cultural function in various societies.[177]

Genetic Potential

Of the various domesticated livestock species, virtually all were introduced to Africa between 5000 B.C. and 2300 B.C., generally from western Asia and the Near East. African farmers and herders have selected for specific attributes over the centuries, and a well-adapted group of local breeds and varieties has developed.

Natural selection and centuries of husbandry have provided African farmers with some 50 types of cattle adapted to specific local conditions. The same process has occurred with sheep and goat breeding. Among the traits which have emerged within African livestock populations, we can identify the following:

- tolerance to trypanosomiasis
- hardiness and stress resistance
- (for sheep) fat concentration in the tail
- (for sheep) development of "hair" sheep, as opposed to wool sheep
- (for cattle) milk production capacity under adverse conditions

During the colonial era, and even following independence, considerable efforts were made to improve local livestock through selection and introduction of foreign genetic material. According to one study, these efforts at breed improvement were "largely ineffective," perhaps in part because the advantages of local breeds were not widely understood.[178] The same study notes that work done at the International Livestock Centre for Africa (ILCA) "have shown that indigenous stocks are more efficient performers than expected and fully warrant further investigation."[179]

Although local breeds -- such as East African Zebu and N'Dama cattle, Djillonke sheep, and West African Dwarf goats -- often exhibit low rates of off-take, weight gain, and breeding efficiency, much evidence suggests that under more optimal management conditions, the same animals would perform considerably better. Poor

nutrition and numerous diseases appear to be the main limitations on productivity. Among the most important diseases and pests faced by livestock in Mid-Africa are trypanosomiasis, rinderpest, contagious bovine pleuro-pneumonia (CBPP), peste des petits ruminants (PPR), anthrax, blackleg, pasteurellosis, African Swine Fever, dermatophilosis, East Coast fever, foot and mouth disease, and a broad range of gastro-intestinal parasites and tick-borne diseases.[180]

Jahnke et al. conclude that the mere fact of livestock survival and moderate productivity under these conditions represents something of an achievement.

> The broad genetic variability of African livestock breeds enables them to exist under harsh environmental conditions of all kinds, including trypanosomiasis infestation if the challenge is not too high.
>
> Environmental pressure continues to maintain a wide range of resistance aptitudes within all breeds. This may be interpreted as a genetic response of the species to risk. In controlled environments such as research stations or experimental farms, African breeds show good performance aptitudes in weight gain, fertility, etc....
>
> Genetic factors do not appear to be a restriction in Africa. Local breeds are able to make the best use of their actual environment, and, with better management, performance can be improved.[181]

Conclusions

Much research remains for livestock production in Mid-Africa. Some of the work will need to focus on disease prevention techniques -- both veterinary and environmental. Other work will need to focus on nutritional issues, herd management, range management, and a variety of other issues. Continued research on animal traction and power will be needed, particularly as population pressures increase the demand for agricultural power within the region.

A major component of this research agenda must be the improvement and selection of livestock breeds. More productive animals can make a profound contribution to the welfare and economic status of African farmers and consumers. Increased production of meat and milk can improve nutritional status directly; earnings from this additional output can add to cash income.

It seems apparent from available research, however, that genetic factors are not the most immediate limitations to improved livestock productivity. Existing breeds are

hardy and well adapted to their surroundings, and improved productivity levels are within reach. Current research shows real promise for the eventual control of trypanosomiasis and other livestock diseases. Livestock will play an increasingly important role in improving the nutrition and income of farmers, and relieving the drudgery of hand cultivation in Mid-Africa.

Footnotes

1 B. Gelaw, ed., To Feed Ourselves: A Proceedings of the First Eastern, Central and Southern Africa Regional Maize Workshop (Mexico, D.F.: Centro Internacional de Mejoramiento de Maiz y Trigo, 1986)

2 Ibid., p. 210.

3 Clifton Hiebsch and Stephen K. O'Hair, "Major Domesticated Food Crops," in Food in Sub-Saharan Africa, ed. Art Hansen and Della E. McMillan (Boulder, CO: Lynne Rienner Publishers, Inc., 1986).

4 Food and Agriculture Organization of the United Nations, Production Yearbook, Vol. 41: 1987 (Rome: FAO, 1988), Tables 15 and 20.

5 Hans E. Jahnke, Dieter Kirschke, and Johannes Lagemann, The Impact of Agricultural Research in Tropical Africa: A Study of the Collaboration between the International and National Research Systems, Study Paper Number 21 of the Consultative Group on International Agricultural Research (Washington, DC: The World Bank, 1987), pp. 144-45.

6 The figures used in the table, which show Nigeria's maize area at 700,000 hectares and its production at 1.4 million mt, are taken from the FAO's 1987 Production Yearbook. These figures -- and the figures for previous years presented in the same table -- represent a drastic and puzzling revision from previous estimates. The 1985 Production Yearbook, for instance, puts Nigeria's maize area at 2200 ha, more than three times the 1987 estimate. Production is estimated at 3 million mt, more than twice the revised total.

The corresponding yield estimates show the difficulties of assessing Nigeria's productivity levels for maize. In the 1985 statistics, Nigeria's yield for 1979-81 is given as 904 kg/ha; the 1987 figures for the same years revise this upward by some 50 percent, to 1333. For 1985, the yield figures are revised from 1364 to 2128, an increase of nearly two-thirds.

The new figures thus show Nigeria to have much lower overall area and production, but dramatically higher yields, than earlier figures. No independent source material is readily available; USDA statistics appear to be based on FAO records for Nigeria.

Available project reports, such as that of the Lafia and Ayangba ADPs by the World Bank, indicate that prevailing yield levels are much closer to the low estimates than to the high ones -- in the 600-1200 kg/ha range, rather

than the 2000 kg/ha range. But it is not clear whether these areas have yield levels indicative of the rest of the country, and it is not possible of course to verify national area or production figures from these reports.

7 M.J.T. Norman, C.J. Pearson and P.G.E. Searle, The Ecology of Tropical Food Crops (Cambridge: Cambridge University Press, 1984), pp. 104 ff.

8 Norman, p. 110.

9 Gelaw, p. 211.

10 Clifton Hiebsch, "Cereal Grain Crops," in Hiebsch and Stephen K. O'Hair, "Major Domesticated Food Crops," in Food in Sub-Saharan Africa, ed. Art Hansen and Della E. McMillan (Boulder, CO: Lynne Rienner Publishers, Inc., 1986), p. 187.

11 Norman, p. 107.

12 Hiebsch, p. 187.

13 Norman, p. 116.

14 D.J.W. Rose, "Maize in Africa -- Planning its Protection Against Pests", Chapter 10 in D.L. Hawksworth, ed., Advancing Agricultural Production in Africa, Proceedings of Commonwealth Agricultural Bureaux's First Scientific Conference in Arusha, Tanzania, February 1984 (Farnham Royal, England: Commonwealth Agricultural Bureaux, 1984), pp. 70-71.

15 Gelaw, p. 212.

16 Norman, p. 104

17 Ibid.

18 Hans E. Jahnke, Dieter Kirschke, and Johannes Lagemann, The Impact of Agricultural Research on Tropical Africa: A Study of the Collaboration between the International and National Research Systems, Study Paper Number 21 of the Consultative Group on International Agricultura Research (Washington, DC: The World Bank, 1987), p. 102. Also, Davic H. Timothy, Paul H. Harvey, and Christopher R. Dowswell, Development and Spread of Improved Maize Varieties and Hybrids in Developing Countries (Washington, DC: U.S. Agency for International Development, Bureau for Science and Technology, 1988), p. 26.

19 R.C. Olver, "The Zimbabwean Maize Breeding Program," in Gelaw, p. 138.

20 Jahnke et al., p. 102.

21 Ibid.

22 J.A.W. Ochieng, "Maize Research in Kenya: An Overview," in Gelaw, pp. 26-27.

23 E.W. Mwenda, "The Maize Program in Kenya," in Gelaw, p. 32.

24 Ibid., pp. 34-35; and Ochiang, pp. 30-31.

25 J.A.W. Ochieng, "Maize Research in Kenya: An Overview," in Gelaw, pp. 26-27.

26 IITA, Strategic Plan: 1989-2000 (Ibadan, Nigeria: IITA, 1989), p. 64.

27 Gelaw, "CIMMYT's Maize Improvement Role in East, Central and Southern Africa," in Gelaw, p. 220.

28 Anderson, TAC report, Chapter 6, p. 12.

29 Ibid.

30 Ibid.

31 A.J. Moshi, "Maize Research in Tanzania," in Gelaw, pp. 112-15. Also, Timothy et al., pp. 24-25.

32 Charles Simkins and William Fenster, "The Effect of Nitrogen Fertilizer Applications on Yield of Maize Variety Gusau-TZB," in 1988 Interim Research Report by the Ministry of Agriculture [Uganda] on Maize, Soybean, and Sunflower Field Trials, photocopied document, date of publication not available. See also, Timothy et al., p. 26.

33 Personal communication, Dr. J.A. Ayuk-Takem, Director, Institute of Agronomic Research, Cameroon.

34 Personal communication, V. Balasubramanian, NCRE Project, Cameroon.

35 CGIAR Task Force on Sub-Saharan Africa, Strengthening Maize and Cassava Research in Eleven Countries of Coastal West and Central Africa (Ibadan, Nigeria: IITA, 1988), p. 34.

36 A. Mpabanzi and E. Ntawuyirusha, "Maize Research in the Economic

Community of the Great Lakes Countries (Burundi, Rwanda and Zaire)" in Gelaw, pp. 88-89.

In Rwanda, research on maize began in 1930 at Rubona. Since then, over 650 varieties from other countries have been brought in for screening. The varieties Golden Corn, Bambu, Katumani, and Nyirakagoli have been introduced. The latter of these represents a product of local selection, and is well adapted to high altitudes. Yield potential is estimated at 3800 kg/ha.[37]

Ibid.

38 Ibid.

39 N.N. Mulamba and M.Y. Asanzi, "Maize Research and Production in Zaire," in Gelaw, pp. 130-35.

40 Ralph W. Cummings, Jr. Food Crops in the Low-Income Countries: The State of Present and Expected Agricultural Research and Technology, Rockefeller Foundation Working Papers (New York: Rockefeller Foundation, May 1976), p. 30.

41 James H. Cock, Cassava: New Potential for a Neglected Crop (Boulder, Westview Press, 1985), pp. 10-11.

42 Ibid.

43 Food and Agriculture Organization of the United Nations, FAO Yearbook of Production Statistics, Volume 41 (Rome: FAO, 1988).

44 It is worthwhile to note that calculating the areas under cassava is a complicated and inherently inaccurate undertaking -- particularly in Africa. Dorosh (1988) cautions that FAO root crop statistics from Africa "are based on extrapolations from small, often dated surveys." For more details, see Paul Dorosh, "A Note on African Root Crops Data" in Underground Crops: Long-Term Trends in Production of Roots and Tubers, by Douglas Horton (Morrilton, Arkansas: Winrock International Institute for Agricultural Development, 1988), p. 21. Dorosh notes that estimates for cassava face the additional difficulty that
"... much of the crop is left in the ground 12 months or more, and in many places planting and harvesting take place throughout the year." Area and yield are also made more difficult to estimate because plant spacing for cassava intercropped with other species varies widely among farming systems.

45 M.J.T. Norman, C.J. Pearson and P.G.E. Searle, The Ecology of Tropical Food Crops (Cambridge: Cambridge University Press, 1984), p. 241.

46 Ibid.

47 Horton, Underground Crops, Tables 1-3. See also, FAO Production Statistics (citation above).

48 Ibid.

49 Ibid.

50 Ibid. (As noted previously, these and all other comparative statistics on agricultural production from Africa should be viewed with some skepticism and considerable caution. Reporting and estimating techniques differ widely from country to country, so consistent data are not necessarily available.)

51 Ibid.

52 Technical Advisory Committee, Consultative Group on International Agricultural Research, International Agricultural Research Centers: Achievements and Potential, a study directed by Jock R. Anderson, Draft Paper of August 31, 1985, Chapter 6, page 14.

53 Ibid., Chapter 19, p. 20.

54 Anderson, Chapter 19, p. 20.

55 Ibid.

56 CGIAR Task Force on Sub-Saharan Africa, Strengthening Maize and Cassava Research in Eleven Countries of Coastal West and Central Africa: Plan of Action -- Request to Donors (Ibadan: IITA in collaboration with the Government of France, Ministry of Cooperation), p. 48.

57 G.W. Otim-Nape and C.N. Ocitti-p'Obwoya, "Aspects of Root Crop Improvement in Uganda," in Root Crops and Low-Input Agriculture: Helping to Meet Food Self-Sufficiency Goals in Eastern and Southern Africa, ed. M.N. Alvarez and S.K. Hahn, Proceedings of the Third Eastern and Southern Africa Regional Root Crops Workshop, held in Mzuzu, Malawi, December 1987 (Ibadan, Nigeria: IITA, 1989), pp. 250-51.

58 L.S.O. Ene, "The Development of Research and Associated Activities at the National Root Crops Research Institute, Umudike, Nigeria," in Root Crops and Low-Input Agriculture: Helping to Meet Food Self-Sufficiency Goals in Eastern and Southern Africa, ed. M.N. Alvarez and S.K. Hahn, Proceedings of the Third Eastern and Southern Africa Regional Root Crops Workshop, held in Mzuzu, Malawi, December 1987 (Ibadan, Nigeria: IITA, 1989), p. 16.

59 International Institute of Tropical Agriculture, IITA Annual Report and Research Highlights: 1987/88 (Ibadan, Nigeria: IITA, 1988), pp 51-53.

60 World Bank, Staff Appraisal Report: Zaire Seeds Project, Report No. 5427-ZR, May 14, 1985, pp. 38, 78.

61 C.M. Githunguri, A.S. Abubaker and Waweru Gitonga, "Cassava Fertilizer Trials at Msabaha Agriculutural Research Centre, Kenya," in Root Crops and Low-Input Agriculture, pp. 89-93.

62 J. Mulindangabo, "First Results of Cassava and Sweet Potato Trials Under Normal Growing Conditions in Rwanda," in Root Crops and Low-Input Agriculture, pp. 180-85.

63 M.A.M. Msabaha, K. Mtambo and A. Nyango, "Root and Tuber Crops Improvement in Mainland Tanzania," in Root Crops and Low-Input Agriculture, pp. 246-47.

64 S.K. Hahn, "Utilization, Production Constraints and Improvement Potential of Tropical Root Crops," in Advancing Agricultural Production in Africa, Proceedings of Commonwealth Agricultural Bureaux's First Scientific Conference (Farnham Royal, England: CAB, 1984), p. 96.

65 Eicher and Baker, p. 124.

66 Anderson, Chapter 6, pp. 14-15.

67 S.K. Hahn, "Breeding Cassava for Pest Resistance with Specific Reference to the Cassava Mealybug and Green Mite," in Root Crops and Low-Input Agriculture: Helping to Meet Food Self-Sufficiency Goals in Eastern and Southern Africa, ed. M.N. Alvarez and S.K. Hahn, Proceedings of the Third Eastern and Southern Africa Regional Root Crops Workshop, held in Mzuzu, Malawi, December 1987 (Ibadan, Nigeria: IITA, 1989), p. 77.

68 See, for example, IITA, "Biological Control Programme: Description and Budget for the Five Years 1988-1992," photocopied document (Cotonou, Benin: IITA Biological Control Programme, April 1989), pp. 3-4.

69 Ibid., pp. 4-6.

70 For an excellent account of the IPM effort, see Edward Glass, "Biological Control of Cassava Pests in Africa" in CGIAR 1987/88 Annual Report, Consultative Group on International Agricultural Research (Washington, DC: CGIAR, 1988),pp. 23-39.

71 Technical Advisory Committee, Consultative Group on International Agricultural Research, International Agricultural Research Centers: Achievements and Potential, a study directed by Jock R. Anderson, Draft Paper of August 31, 1985, Ch. 19, p. 12.

72 G.W. Otim-Nape and C.N. Ocitti-p'Obwoya, "Aspects of Root Crop Improvement in Uganda," in Root Crops and Low-Input Agriculture: Helping to Meet Food Self-Sufficiency Goals in Eastern and Southern Africa, ed. M.N. Alvarez and S.K. Hahn, Proceedings of the Third Eastern and Southern Africa Regional Root Crops Workshop, held in Mzuzu, Malawi, December 1987 (Ibadan, Nigeria: IITA, 1989), pp. 250-51.

73 Michael Lipton with Richard Longhurst, Modern Varieties, International Agricultural Research, and the Poor, Consultative Group on International Agricultural Research Study Paper Number 2 (Washington, DC: The World Bank, 1985), p. 77.

74 Anderson, Chapter 19, Appendix Table 19.4.

75 P.C. Gupta and J.C. O'Toole, Upland Rice: A Global Perspective (Los Banos, Philippines: International Rice Research Institute, 1986), p. 1.

76 International Rice Research Institute, IRRI Rice Facts 1988 (Los Banos: IRRI, 1988).

77 Gupta and O'Toole, p. 7.

78 Surajit K. De Datta, Principles and Practices of Rice Production (New York: John Wiley & Sons, 1981), p. 253.

79 International Institute of Tropical Agriculture, IITA Strategic Plan: 1989-2000 (Ibadan: IITA, 1989), pp. 26, 52.

80 Gupta and O'Toole, p. 117.

81 Gupta and O'Toole, p. 118.

82 Ibid.

83 West African Rice Development Association, Annual Report 1987 (Bouake, Côte d'Ivoire, 1988), p. 4.

84 Ibid., p. 6.

85 Te-Tzu Chang, "Crop History and Genetic Conservation: Rice -- A Case Study," in Iowa State Journal of Research, Vol. 59, No. 4, May 1985, pp. 425-35.

86 WARDA, Strategic Plan, 1990-2000 (Bouake: WARDA, 1988), p. 27.

87 Ibid., p. 22.

88 R. Swennen and D. Vuylsteke, "Plantains in West and Central Africa: Importance, Production Constraints, and Prospects for Improvement," photocopied paper presented at the Fourth West and Central Africa Root Crops Workshop, held at Lomé, Togo, 12-16 December 1988, p. 3.

89 Ibid., p. 3.

90 Swennen and Vuylsteke, p. 2.

91 Paul Dorosh, Economics of Production and Utilization of Plantains in Africa (Ibadan, Nigeria: International Institute of Tropical Agriculture, 1988), p. 1.

92 Dorosh, p. 1.

93 Dorosh, p. 11.

94 Ibid., p. 3.

95 Dorosh, pp. 2-6.

96 Swennen and Vuylsteke, p. 4.

97 Cited by Dorosh, p. 11. Confirmed by personal communication with Perrault.

98 T.O.C. Ndubizu and E.I. Okafor, "Growth and Yield Patterns of Nigerian Plantains," in Fruits, Vol. 31, No. 11, 1976, p. 672.

99 D.S.O. Osiru and J.K. Mukiibi, "Banana-Based Cropping Systems in Uganda," in R.A. Kirkby, ed., Crop Improvement in Eastern and Southern Africa: Research Objectives and On-Farm Testing," proceedings of a

regional workshop held in Nairobi, Kenya, 20-22 July 1983 (published as IDRC 218e, publication date and location unknown), pp. 94-95.

100 V.F. Malima, "Banana and Plantain Growing in Tanzania,"in Fruits, Vol. 31, No. 11, 1976, p. 651.

101 P. Devos, G.F. Wilson, and E. De Langhe, "Plantain: Genetic Resources and Potential in Africa," in Crop Genetic Resources in Africa, Proceedings of a workshop jointly organized by the Association for the Advancement of Agricultural Sciences in Africa and the International Institute of Tropical Agriculture, held at IITA in Ibadan, Nigeria, 4-6 January, 1978 (Ibadan: IITA, 1980), p. 161.

102 Swennen and Vuylsteke, p. 3.

103 Devos et al., p. 162.

104 Swennen and Vuylsteke, p. 2.

105 G.F. Wilson, "Status of Bananas and Plantains in West Africa," in Banana and Plantain Breeding Strategies, ACIAR Proceedings No. 21, Proceedings of an International Workshop held at Cairns, Australia, 13-17 October 1986, ed. G.J. Persley and E.A. De Langhe (Canberra: ACIAR, 1987), p. 32.

106 Hugues Tezenas du Montcel, Plantain Bananas, in the Tropical Agriculturalist Series, CTA (Technical Centre for Agricultural and Rural Cooperation, established under the ACP-EEC Convention of Lomé), Translated by Paul Skinner; series editor, René Coste (London: MacMillan, 1987), pp. 16-17.

107 Wilson, p. 31.

108 Data from Flinn and Hoyoux are reported in Wilson, p. 32.

109 Wilson, p. 32.

110 IITA, Annual Report 1981: Plantain Research Project (Ibadan, Nigeria: IITA, 1982), p. 4.

111 Ibid.

112 Swennen and Vulysteke, p. 5.

113 R. Swennen, G.F. Wilson, and D. DeCoene, "Priorities for Future Research on the Root System and Corm in Plantains and Bananas in Relation with Nematodes and the Banana Weevil," in Nematodes and the Borer Weevil in Bananas: Present Status of Research and Outlook, proceedings of a workshop held in Bujumbura, Burundi, 7-11 December 1987 (INIBAP, 1988), pp. 91-96.

114 IITA Research Briefs, Vol. 8, No. 1, March 1987.

115 J.L. Dale, "Banana Bunchy-Top Virus: A Continuing Threat," in Banana and Plantain Breeding Strategies, ACIAR Proceedings No. 21, Proceedings of an International Workshop held at Cairns, Australia, 13-17 October 1986, ed. G.J. Persley and E.A. De Langhe (Canberra: ACIAR, 1987), p. 124.

116 Ibid.

117 Tezenas du Montcel, p. 85.

118 Swennen and Vuylsteke, pp. 4-5.

119 Ibid.

120 Edmond De Langhe, "Towards an International Strategy for Genetic Improvement in the Genus **Musa**," in Banana and Plantain Breeding Strategies, ACIAR Proceedings No. 21, Proceedings of an International Workshop held at Cairns, Australia, 13-17 October 1986, ed. G.J. Persley and E.A. De Langhe (Canberra: ACIAR, 1987), p 19.

121 Swennen and Vuylsteke, p. 7.

122 Ibid.

123 Dorosh, pp. 13-14.

124 L.R. House, A Guide to Sorghum Breeding, Second Edition (Patancheru, A.P., India: International Crops Research Institute for the Semi-Arid Tropics, 1985), pp. 4-7.

125 D.S.C. Spencer and M.V.K. Sivakumar, "Pearl Millet in African Agriculture," in Proceedings of the International Pearl Millet Workshop, 7-11 April 1986, sponsored by INTSORMIL and ICRISAT (Patancheru, A.P., India: ICRISAT, 1987), pp. 19-21. See also, David J. Andrews, "Millet Breeding for Low-Resource Agriculture in Africa," background paper for the Office of Technology Assessment, U.S. Congress, Enhancing Agriculture in Africa:

A Role for U.S. Development Assistance, Volume 2, Part D, Technology Papers, Document PB88-201322, December 1987, p. 378.

126 John H. Martin, Warren H. Leonard, and David L. Stamp, Principles of Field Crop Production, Third Edition (New York: MacMillan, 1976), p. 386.

127 International Crops Research Institute for the Semi-Arid Tropics (ICRISAT), Annual Reports, 1987 and 1988 (Patancheru, A.P., India: ICRISAT, 1988 and 1989). See also, ICRISAT, ICRISAT in Africa (Patancheru, A.P., India: ICRISAT, 1986), p. 54.

128 W.W. Hanna, "Utilization of Wild Relatives of Pearl Millet," in Proceedings of the International Pearl Millet Workshop, 7-11 April 1986, sponsored by INTSORMIL and ICRISAT (Patancheru, A.P., India: ICRISAT, 1987), pp. 33-34.

129 International Crops Research Institute for the Semi-Arid Tropics, ICRISAT in Africa (Patancheru, A.P., India: ICRISAT, 1986), p. 54.

130 World Bank Western Africa Projects Department, West Africa Agricultural Research Review, a special study for the World Bank, presented in Washington, DC, 28 February 1987, p. 102.

131 Food and Agriculture Organization of the United Nations, Production Yearbook 1988 (Rome: FAO, 1989), pp. 130-33.

132 Uma Lele, Robert E. Christiansen and Kundhavi Kadiresan, Issues in Fertilizer Policy in Africa: Lessons from Development Programs and Adjustment Lending, 1970-87, in a paper for the symposium on Managing Agricultural Development in Africa (MADIA), held at the World Bank, June, 1989, p. 31.

133 See, for example, FAO, African Agriculture: The Next 25 Years -- Annex V, Inputs Supply and Incentive Policies (Rome: FAO, 1986), p. 105. Also, M.S. Mudahar, "Fertilizer Problems and Policies in Sub-Saharan Africa," in Management of Nitrogen and Phosphorus Fertilizers in Sub-Saharan Africa, ed. A. Uzo Mokwunye and Paul L.G. Vlek, Proceedings of a symposium held in Lomé, Togo, March 25-28, 1985, published as Volume 24 of the series Developments in Plant and Soil Sciences (Dordrecht: Martinus Nijhoff Publishers, 1986), p. 16. Also, Lele et al., p. 18.

134 M.J.T. Norman, C.J. pearson and P.G.E. Searle, The Ecology of Tropical Food Crops (New York: Cambridge University Press, 1984), p. 134.

135 D.J. Andrews, L.K. Mughogho, and S.L. Ball, "Sorghum and Pearl Millet Production in Africa: Problems and Prospects with New Varieties," Chapter 14 in Advancing Agricultural Production in Africa, Proceedings of the Commonwealth Agricultural Bureaux' First Scientific Conference, Arusha, Tanzania, 12-18 February, 1984 (Farnham Royal, England: CAB, 1984), p. 87.

136 Andrews et al., pp. 86-87.

137 Ibid. Also, Robert D. Havener, personal communication.

138 Andrews et al., p. 87.

139 Andrews et al., p. 88.

140 See, for example, Eicher and Baker, p. 119.

141 Andrews et al., p. 88.

142 Dr. J.A. Ayuk-Takem, Directeur, Institut de la Recherche Agronomique, Cameroon, personal communication, 17 August 1989.

143 ICRISAT in Africa, p. 37.

144 Ignacio Narvaez, Jose Antonio Valencia, and Chris Dowswell, "Sasakawa-Global 2000 Agricultural Project in the Sudan," photocopied draft paper dated July 15, 1989, p. 9.

145 R.P. Jain, "Progress Report on Field Programme in Lusaka Province," in Zambia Global 2000-BCCI Annual Report 1987-88, photocopied draft manuscript, p. 38.

146 Andrews et al., p. 89.

147 V. Balasubramanian, NCRE Project, personal communication.

148 Andrews, "Millet Breeding for Low Resource Agriculture in Africa," p. 379.

149 FAO, FAO Fertilizer Programme: 25 Years, 1961-1986 (Rome: FAO, 1987), p. 74.

150 West Africa Agricultural Research Review, p. 105.

151 Eicher and Baker, p. 118.

152 D.J. Andrews, L.K. Mughogho, and S.L. Ball, "Sorghum and Pearl Millet

Production in Africa: Problems and Prospects with New Varieties," Chapter 14 in Advancing Agricultural Production in Africa, Proceedings of the Commonwealth Agricultural Bureaux' First Scientific Conference, Arusha, Tanzania, 12-18 February, 1984 (Farnham Royal, England: CAB, 1984), p. 88.

153 FAO, Production Yearbook 1988 (Rome: FAO, 1989), p. 237.

154 John H. Martin, Warren H. Leonard and David L. Stamp, Principles of Field Crop Production, Third Edition (New York: Macmillan, 1976), pp. 812-16.

155 Ayuk-Takem, personal communication.

156 Uma Lele, Nicolas Van de Walle, and Mathurin Gbetibouo, "Cotton in Africa: An Analysis of Differences in Performance," a paper prepared for the MADIA Symposium on Managing Agricultural Development in Africa, and presented in Washington, D.C. at the World Bank, June, 1989, p. 5.

157 Ibid., p. 10.

158 Ibid., p. 10.

159 Ibid., p. 14.

160 Ibid, pp. 12-14.

161 West Africa Agricultural Research Review, pp. 134-36.

162 Ibid., p. 136.

163 FAO, Production Yearbook 1988 (Rome: FAO, 1989); and FAO, Trade Yearbook 1987 (Rome: FAO, 1988).

164 Ibid.

165 C.N. Williams and W.Y. Chew, Tree and Field Crops of the Wetter Regions of the Tropics, Intermediate Tropical Agriculture Series (Hong Kong: Longman, 1980), pp. 60-63.

166 Mudahar, p. 16.

167 Agland Investment Services Inc., Coffee Sub-Sector Study for the African Development Bank: Volume II -- Robusta, Case Studies from Cameroon, Côte d'Ivoire, and Uganda (Larkspur, Calif.: Agland Investment Services Inc, June 1989), p. 13, 57-60.

168 West Africa Research Review, p. 152.

169 Williams and Chew, pp. 67-68.

170 D.J. Walyaro, H.A.M. van der Vossen, J.B.O. Owuor and D.M. Masaba, "New Varieties to Combat Old Problems in Arabica Coffee Production in Kenya," in Advancing Agricultural Production in Africa (CAB, reference above).

171 World Bank, Eastern and Southern Africa Projects Department, Eastern and Southern Africa Agricultural Research Review, a consultant's report to the Bank (Washington, DC: The World Bank, 1987), pp. 40-41.

172 Agland, Coffee Sub-Sector Study, Uganda section, pp. 33-34.

173 H.E. Jahnke, G. Tacher, P. Keil and D. Rojat, "Livestock Production in Tropical Africa, with Special Reference to the Tsetse-Affected Zone," in Livestock Production in Tsetse Affected Areas of Africa, proceedings of a meeting of the African Trypanotolerant Livestock Network, held 23-27 November 1987 in Nairobi, Kenya (Nairobi: International Livestock Centre for Africa and the International Laboratory for Research on Animal Diseases, 1988), pp. 3-4.

174 Jahnke et al., pp. 3-4.

175 West Africa Research Review, p. 189.

176 William I. Jones and Roberto Egli, Farming Systems in Africa: The Great Lakes Highlands of Zaire, Rwanda, and Burundi, World Bank Technical Paper Number 27 (Washington, DC: The World Bank, 1984), pp. 91-93.

177 Jahnke et al., p. 9.

178 West Africa Agricultural Research Review, p. 204.

179 Ibid.

180 Ibid., p. 203. See also, Eicher and Baker, p. 173.

181 Jahnke et al., p. 10.

CHAPTER 4

MAINTENANCE AND IMPROVEMENT OF SOIL FERTILITY

Introduction

Soils represent one of the major physical inputs in agricultural production. Along with genetic material, water and sunlight, soil fertility serves as a fundamental component of virtually all plant production systems.

The technological potential of Mid-Africa's agriculture is closely related to the soil conditions prevailing in the region. Soils are generally poor, and soil fertility is a severe constraint to most of Mid-Africa's agriculture.

In order for agricultural production to increase at the pace required to meet the region's needs, vastly increased use of inorganic (chemical) fertilizers will be absolutely essential. Chemical fertilizers are undoubtedly the most important single technology for Mid-African agricultural development.

Current rates of fertilizer use are virtually zero in much of the region, and it is inconceivable that productivity can increase as needed without enormous growth in fertilizer use. Within a few decades, at most, chemical fertilizer use in Mid-Africa must increase to 40-50 kg/ha if yield requirements are to be met.

At the same time, experience has shown clearly that chemical fertilizers alone will not solve the problems of low -- and declining -- soil fertility in Mid-Africa. Efforts to increase the use of fertilizers must be complemented by efforts to redress the loss of inherent soil fertility.

These efforts will include erosion control and improvement of the organic matter content of soils. The control of soil acidity and the levels of trace elements will also be crucially important.

Without appropriate attention to these and other issues of long-term soil fertility, the heavy use of chemical fertilizers will, at best, result in serious inefficiencies. At worst, it could have the potential to exacerbate Mid-Africa's soil fertility problems.

Above all, fertilizer policy and soil fertility must be placed high on the list of concerns for governments, donor organizations, and all others concerned with the welfare of the Mid-Africa region. Although a few countries -- such as Rwanda -- have begun to

recognize the importance of these issues, this viewpoint has not yet taken hold on a widespread basis. Until it does, the prospects for agricultural production gains in Mid-Africa are dim.

Mid-African Soils: A Description

About 70 percent of Mid-Africa's geographic area is covered by acid soils with relatively low levels of native fertility. Several terminologies exist for describing soils; in U.S. terms, however, Mid-Africa's soils belong mostly to the orders of oxisols, ultisols, with some inceptisols (dystropepts) or entisols (psamments). The fringe area of the Mid-Africa zone is mostly covered by alfisols. Agronomists often separate these soils into three groups, based on their different environments:

1. Humid Lowlands: Acid soils located at less than 600 m elevation, with a native forest vegetation, receiving high levels of annual rainfall, which have frequently been transformed over time by lateral displacements and redistribution of the pedons. These soils are moderately acid in the surface layer and have been successfully used for perennial crop and root crop production. They extend from the Congo Basin to southern Cameroon and southern Nigeria.

2. Mountainous Highlands: Acid soils located at higher elevations (above 600 m and in the highlands), with well-defined dry and wet seasons and a sparser vegetation, mostly savanna. These soils, generally less subjected to displacements and material redistribution, are more intensively leached and are very acidic. They extend from eastern/southern Zaire to East Africa. Intensive agriculture is difficult due to the very low chemical fertility.

3. Moist Savanna: Moderately acid soils (alfisols) located on the northern and southern fringes of the humid lowlands zone. Annual rainfall is 1000 to 1200 mm, distributed over a period of four to six months. These soils can be used for cereals and root crop production; their native fertility status is higher than that of soils in the humid lowlands. These soils degrade rapidly, however, if appropriate conservation measures are not undertaken.

Major characteristics of these acid soils generally include a high degree of weathering, high acidity -- often associated with high levels of aluminum toxicity -- low nutrient retention capacity, high content of iron and aluminum oxides (especially in oxisols) and the predominance of kaolinitic clays among the clay fraction. Effective rooting depth, available water, and plant nutrient reserves are generally low. Susceptibility to erosion and compaction is high.

30-597 - 0 - 90 - 11

In Western Africa -- including Cameroon and Nigeria -- another group of acid soils is frequently found: alfisols which have undergone severe acidification processes. These soils have considerably higher levels of native fertility, but the maintenance of that fertility under intensive use has posed serious problems in the past.

Other soils observed in the Mid-Africa region, mostly in the highlands, and which have a good potential for agricultural production include vertisols, mollisols, inceptisols (andepts), and entisols (fluvents). All together, they probably cover less than 10% of the region.

Traditionally, shifting cultivation has represented the main form of soil management in the Mid-Africa region. This system, based on an alternation of short periods of food crops cultivation (a few years) and longer periods during which the soil remains fallow (20 years or more) has been successful in maintaining fertility equilibrium over time, while minimizing the processes of soil degradation leading to severe erosion.

In more recent times, however, increased demand for crop production has contributed to sharp declines in the length of fallow periods, particularly in areas of high population density. In extreme cases -- as, for example, in Rwanda and Burundi -- the soil may be placed under continuous food crop cultivation.

Scientific research, confirmed by the experience of farmers in many areas, has disproved the widespread notion that soils in the humid tropics possess such poor chemical and physical properties that they cannot support a sustainable agriculture over long periods of time. This is a myth which must be discarded.

Nonetheless, the fact remains that without proper management -- specifically, fertilization and soil conservation measures -- most of these soils quickly deteriorate under intensive use. The loss of fertility can involve acidification, degradation, and severe erosion. By contrast, given appropriate fertilization and management, soil properties can actually improve with time under continuous cultivation systems, as indicated by studies done in Africa and Latin America.

FAO land potentiality studies confirm that opinion by characterizing the potential for rainfed agriculture on Mid-African soils as "medium to high with good management." FAO cites "potential problems with soil acidity, phosphate deficiency, and aluminum and iron toxicity"; but these can be neutralized with appropriate inputs and agronomic practices. The FAO report notes that "although constraints are widespread, their presence does not mean that the soils cannot produce, but that high yields will not be obtained unless the constraints are removed or overcome."

Managing Mid-Africa's Soil Fertility: The Challenge of Intensified Production

Transforming traditional systems of shifting cultivation into more intensive management systems is a delicate operation for which examples of failures abound. Intensive use of heavy equipment has led to degradation of the soil structure. Reduction of fallow time has contributed to increased weed problems. Soils have grown increasingly acidified because of shorter fallow times, use of mineral fertilizers, the introduction of tillage, and the increased uptake of soil nutrients. New crop varieties have proven less well adapted than traditional varieties to the chemical environment of soil surface layers, with resulting poor productivity levels.

The improvement of soil fertility under these conditions implies a sustained fertilization program, in conjunction with the introduction of soil and crop management systems such as alley cropping, which allow an efficient recycling of nutrients. In the case of extreme nutrient depletion or acidification, two successive fertilization steps have been proposed: "corrective fertilization" followed by "maintenance fertilization."

This approach, developed by IRAT, aims to overcome the main mineral soil deficiencies, using a one-time heavy rate of fertilizer or lime, followed by annual maintenance levels of fertilizer application. However, as C. Pieri points out: "Whereas maintenance fertilization is highly profitable and must be paid by the farmers themselves, corrective fertilization is considered a 'national' investment. Its cost, therefore, is ideally supported by the government, or international aid agencies, and not by the individual farmer."[1]
Moreover, the adoption of this technology and the success of this approach -- very positive at the research station -- is somewhat in question in Africa because of a variety of economic and human constraints which include pricing policies, availability and distribution of inputs, and cash flow problems.

Complements to Chemical Fertilizers

As noted in the introduction, chemical fertilizers will play a vital role in the future management of Mid-Africa's soil fertility. For a variety of reasons, however, chemical fertilizers alone cannot address all the region's needs. The high cost of chemical fertilizers, their limited availability, and the economic constraints to their use all indicate the need for a variety of complementary activities.

In addition, over the long term, heavy use of chemical fertilizers can contribute to problems of soil degradation if careful attention is not given to erosion control, organic matter content, soil acidity, trace elements, and a range of other issues.

This implies a need for technologies to complement chemical fertilizer use. These will include such management practices as soil conservation -- through contour planting, terracing, and use of soil-holding plants such as vetiver grass and sesbania. Organic fertilization also will play an important role, especially since studies in West and Central Africa are increasingly showing a high degree of complementarity between the build-up of organic matter and the efficient use of chemical fertilizers.[2] This suggests the value of such techniques as composting, growing of green manures, and other techniques of adding organic matter to the soil.

As Borin writes, "organic-based fertilizers have proven very effective over a wide range of soil and crop conditions. They are particularly suitable for local, small-scale production activities based on the usage of concentrated sources of agricultural and agro-industrial wastes."[3] These materials can often be produced at a relatively low cost, compared to chemical fertilizers. There is also some speculation that the use of organic-based fertilizers may lower the need for pesticides by promoting soil biological activity, and that aluminum detoxification may be promoted by using green manures.[4]

It is unrealistic, of course, to imagine that the use of organic fertilizers alone can be fully satisfactory under conditions of intensive cultivation on acid, nutrient-depleted soils. In this situation, organic fertilizers may still have a role in supplementing chemical fertilizers. A typical mixture might include a balanced NPK fertilizer, lime and trace mineral supplements, combined with improved or inoculated compost and ground phosphate rock.

Chemical Fertilizers: Use and Responses in Mid-Africa

For humid Mid-Africa, chemical fertilizers will without any question provide one of the keys to increased agricultural productivity. Fertilizer technology is already well understood and tested; it is also readily available and of demonstrated effectiveness through the region.

Researchers in Africa have reported excellent responses to both nitrogen and phosphorus fertilizer, as well as to varying levels of micronutrients. Surprisingly little information is available, however, that describes these crop yield responses in quantitative terms.[5]

Much of the available data comes from the FAO Fertilizer Programme, which began in 1961 as part of a joint industry-government collaborative research effort. Between 1961 and 1987, the Programme conducted some 8,470 trials in Africa, along with 72,030 demonstrations. Over one million farmers attended more than 50,000 field

days held in Africa to disseminate information on fertilizer use; the FAO estimates that 20 percent of these farmers were women.[6]

FAO's efforts, along with similar work by the International Fertilizer Development Council, have generally indicated that fertilizers can dramatically improve crop yields and overall production levels in Africa. In most cases, the results suggest that increased yields justify in economic terms the added outlay required to pay for fertilizer inputs. The manager of the Fertilizer Programme has written that "the results of the trials and demonstrations, all carried out in farmers' fields, have shown that yields can be doubled, under the prevailing low to medium technology levels."[7]

For instance, FAO results suggest that in seven Sub-Saharan African countries, chemical fertilizers produced sharp increases in maize yields. On average, each kilogram of plant nutrient applied at profit-maximizing rates produced 13 additional kilograms of maize. (Higher responses can sometimes be achieved under less profitable fertilizer regimes.)

The maize response figures ranged from a low of 6:1 in Madagascar to a high of 21:1 in Rwanda.[8] Other continent-wide crop averages reported by FAO are 9:1 for sorghum and pulses, 8:1 for rainfed rice, 10:1 for irrigated rice, and 8:1 for millet.[9]

A more extensive presentation of response results for maize is included below as Table 1. This table condenses the results of fertilizer responses reported by FAO, national and international research centers, and other sources. A crude numeric average of the fertilizer responses reported by the various sources gives a figure of 12:1 for maize -- very close to the FAO average reported above.

All these fertilizer response data must be treated with some caution. Fertilizer response data are generally taken either from experiment station trials or from on-farm trials that are designed and managed much as though they were on-station. For example, most of the trials are carried out under mono-cropping, as opposed to the mixed cropping systems employed by farmers. Other agronomic practices (e.g., weeding, cultivating) are probably also more intensive on trial plots than on typical farm fields. As a result, farmers may not actually achieve the high levels of response reported in test results.

Similarly, the actual profitability of fertilizer use for farmers may also dictate different patterns of application from the supposedly "profit-maximizing" levels recorded in experiments. In general, farmers probably face higher total costs and lower actual crop prices than those used by scientists to calculate "best" applications of fertilizer. At low levels of fertilizer use, response coefficients may vary considerably from those reported in Table 1.

Table 1

MAIZE -- FERTILIZER RESPONSES

Country	Region	Source	Dates	Trial/Dem	#Trials	CntYield	N	P	K	BstYield	AddYield	Val/Cst	KgY/KgNut
Botswana		FAO (1)	1969-75	Trial	33	1322	0.0	45.8	0.0	1946	624	2.9	13.6
Botswana		FAO (1)	1969-75	Demo	53	1242	40.0	45.8	0.0	2286	1044	2.5	12.2
Botswana		Mudahar/FAO	1961-71	(Average)	.	.	.	.	.	.	.	.	4.9
Burkina Faso		FAO (1)	1975-81	Demo	54	802	60.0	50.0	0.0	1902	1100	3.2	10.0
Burkina Faso		FAO (2)	1961-86	(Average)	.	.	.	.	.	.	.	.	11.0
Burundi		FAO (1)	1972-81	Trial	4	1658	30.0	40.0	0.0	3403 *	1745	7.6	24.9
Burundi		FAO (1)	1972-81	Demo	207	1639	40.0	60.0	0.0	2901	1262	3.8	12.6
Cameroon	CentreSud	FAO (1)	1966-73	Trial	505	975	22.5	22.5	22.5	1685	710	2.7	10.5
Cameroon		Mudahar/FAO	1961-71	(Average)	.	.	.	.	.	.	.	.	9.8
Cote d'Ivoire		Mudahar/FAO	1961-71	(Average)	.	.	.	.	.	.	.	.	10.3
Ethiopia		FAO (1)	1967-78	Trial	32	2170	23.0	23.0	0.0	3280	1110	7.2	24.1
Ethiopia		Mudahar/FAO	1961-71	(Average)	.	.	.	.	.	.	.	.	15.1
Gambia		FAO (2)	1961-86	(Average)	.	.	.	.	.	.	.	.	8.0
Ghana		Mudahar/FAO	1961-71	(Average)	.	.	.	.	.	.	.	.	11.9
Kenya	Western	DeGeus	1966-67	Trial	11	4080	0	56	0	4160	80	0.3	1.4
Kenya	Western	DeGeus	1966-67	Trial	11	3860	70	0	0	4380	520	1.0	7.4
Kenya		FAO (1)	1968-74	Trial	12	2968	40.0	40.0	0.0	3593	625	1.6	7.8
Kenya		FAO (1)	1968-74	Demo	2391	3124	60.0	60.0	0.0	4791	1667	2.8	13.9
Kenya		Mudahar/FAO	1961-71	(Average)	.	.	.	.	.	.	.	.	14.6
Lesotho		FAO (1)	1969-75	Trial	78	1590	40.0	20.0	0.0	3049	1459	2.6	24.3
Lesotho		FAO (1)	1969-75	Demo	29	1030	44.0	50.0	24.0	1814	784	2.0	6.6
Lesotho		FAO (2)	1961-86	(Average)	.	.	.	.	.	.	.	.	16.0
Madagascar		FAO (2)	1961-86	(Average)	.	.	.	.	.	.	.	.	6.0
Nigeria	Bendel	Mudahar	1976	na	na	na	75	34	34	na	836	6.6/1.8**	5.8
Nigeria	Kwara	FAO (1)	1969-73	Trial	76	871	79.0	32.0	0.0	2480	1609	6.1	14.5
Nigeria	Kwara	FAO (1)	1969-73	Demo	691	807	73.0	40.0	0.0	2197	1390	3.6	12.3
Nigeria	Plateau	FAO (1)	1978-79	Trial	6	1163	132.0	38.0	45.0	2573	1410	12.1	6.6
Nigeria		Mudahar/FAO	1961-71	(Average)	.	.	.	.	.	.	.	.	9.5
Rwanda		FAO (2)	1961-86	(Average)	.	.	.	.	.	.	.	.	21.0
Tanzania		FAO (2)	1961-86	(Average)	.	.	.	.	.	.	.	.	12.0
Togo		Mudahar/FAO	1961-71	(Average)	.	.	.	.	.	.	.	.	6.5
Uganda	Makerere	Hakiza/Simki	1988	Experimen	1	na	0.0	90.0	90.0	5800	na	na	na
Uganda	Makerere	Hakiza/Simki	1988	Experimen	1	na	75.0	90.0	90.0	7800	na	na	na
Uganda	Makerere	Hakiza/Simki	1988	Experimen	1	na	150.0	90.0	90.0	8300	na	na	na
Uganda	Makerere	Simkins/Fens	1988	Experimen	1	na	0.0	120.0	120.0	8100	na	na	na
Uganda	Makerere	Simkins/Fens	1988	Experimen	1	na	90.0	120.0	120.0	9600	na	na	na
Uganda	Makerere	Simkins/Fens	1988	Experimen	1	na	180.0	120.0	120.0	9750	na	na	na
Uganda	Masindi	Imanywoha/Mi	1987-88	Trial	3	3413	90.0	60.0	0.0	6146	2733	na	18.2
Uganda	Luwero	Imanywoha/Mi	1987-88	Trial	5	3303	90.0	60.0	0.0	6597	3294	na	22.0
Uganda	Masaka	Imanywoha/Mi	1987-88	Trial	9	1825	90.0	60.0	0.0	3764	1939	na	12.9
Zaire		FAO (1)	1972-81	Trial	2	1537	100.0	60.0	30.0	3977	2440	3.2	12.8
Zaire		FAO (1)	1972-81	Demo	82	1443	63.0	45.0	28.0	3077	1634	4.0	12.0
Zaire		FAO (2)	1961-86	(Average)	.	.	.	.	.	.	.	.	12.0
Zambia		FAO (2)	1961-86	(Average)	.	.	.	.	.	.	.	.	11.0

A final caution concerns the effects of chemical fertilizers on Mid-African soils over extended time periods. Chemical fertilizers can be extremely effective in promoting short-run yield increases, but they will not have any great positive impact on soil physical properties or overall fertility. On the contrary, the inordinate use of some chemical fertilizers -- ammonium sulfate, for example -- can have a detrimental effect on the chemical fertility: e.g., increased acidification, resulting in lower availability of phosphorus and minor elements. And finally, traditional NPK fertilizers do not address the needs for other essential micronutrients, such as calcium, magnesium, sulfur, boron, and zinc.

With these caveats in mind, however, the main point remains: chemical fertilizers do indeed produce vast improvements in crop yields under appropriate management conditions. Yield levels produced with fertilizers under experimental conditions can rival those of developed countries; in Uganda, for instance, researchers posted yields of 9.6 tons per hectare using fertilizers and supplemental irrigation. (The figure represents about nine times the African average maize yield, and more than six times the Ugandan average.)[10]

The role of phosphorus fertilizers in Mid-Africa is an interesting sidelight. Phosphorus deficiency has long been blamed as a cause for low yield levels in Africa. Phosphorus deficiencies lower crop production on their own; they can also lessen the ability of plants to use available nitrogen. In fact, nitrogen deficiency is in some cases a symptom of phosphorus deficiency.[11] In consequence, some experts have contended that the widespread use of phosphorus fertilizer -- even in crude forms, such as crushed phosphate rock -- could raise crop productivity by 5 to 20 percent with no other technological change.[12]

A study by Bationo, Mughogho and Mokwunye notes, however, that relatively small quantities of phosphorus fertilizers can redress the deficiencies in most cases. "The myth that tropical African soils have unquenchable thirst for phosphorus may be finally put to rest," they state.[13]

Patterns of Use

The need for chemical fertilizers in Mid-Africa stands in stark contrast with current patterns of use. Africa as a whole ranks far behind all other regions of the world in fertilizer usage. As of 1980, fertilizer use in Africa averaged 9 kg per hectare of arable land, compared with 41 kg/ha in Latin America and 38 kg/ha in South and East Asia.[14] By comparison, developed countries averaged over 100 kg/ha of nutrient consumption during the same period.[15] Individual country statistics on fertilizer use vary considerably within Africa. For instance, Kenya and Zimbabwe reported fertilizer

consumption figures of 46 kg/ha and 62 kg/ha respectively for 1985, while totals under 1 kg/ha were estimated for Uganda, Guinea and Botswana.[16]

For Mid-Africa as a whole, the numeric average of country fertilizer consumption figures gives a total of 8.5 kg/ha. Country performances range from Uganda (0 kg/ha) and Zaire (1.0 kg/ha) to Cameroon (8.1 kg/ha) and Kenya (46 kg/ha).[17] The full list of figures is included as Table 1.

Given the low levels of fertilizer consumption in Africa, it might appear likely that growth rates of fertilizer use would be high. Mudahar notes, however, that annual compund growth rates from 1969-71 to 1979-81 averaged about 7 percent -- again lagging behind the rest of the developing world.[18] In a number of countries, fertilizer use fell sharply, possibly as a result of overall economic deterioration or foreign exchange constraints. Fertilizer use thus shows no signs of rapid acceleration in Africa.

National aggregate figures for fertilizer use tend to obscure an important pattern concerning consumption within countries: with a few exceptions, most fertilizer -- and other inputs -- go to exportable cash crops rather than to staple food crops. Eicher and Baker suggest that "fertilizer use is ... almost totally restricted to cash crops such as tobacco, cotton, tea, and groundnuts."[19] Mudahar estimates that "one-half to two-thirds of fertilizer is used on export crops." He notes that this "is partly a reflection of the fact that fertilizer use is relatively more profitable on export crops than on food crops."[20]

This suggests that chemical fertilizer use is probably near zero for subsistence farmers in most of mid-Africa. Those small farmers who do use fertilizer probably can be assumed to have small mixed farms, in which cash income from export crops (e.g., coffee and cocoa) is used to purchase inputs. Most of the inputs are used on the cash crop, but some residual may be applied to staple food crops. Jones and Egli refer to such systems in their study of highland agriculture in Zaire, Rwanda and Burundi. It is worthwhile to note that under these systems, there may be some minor residual effects from fertilizers for those crops that <u>follow</u> the cash crops in a rotation. If nutrients remain in the soil, they may provide a minor production boost for staple crops.[21]

Increasing attention has been devoted in recent years to the use of organic fertilizers in Africa (e.g., compost, animal manure, human wastes, leguminous plants for green manuring, etc.). There are few figures to suggest the current level of use of such inputs. Certainly these materials can be as effective as chemical fertilizers of similar composition, and they offer the added benefits of improving soil physical structure and tilth. In some of Africa's mixed farming systems, however, animals range free, and manure collection is difficult. Jones and Egli describe some of the problems with

organic fertilization even under the highly intensive production systems of the Great Lakes highlands:

> A man or woman who carries a 20 kg. load of manure to the field adds less than half a kilogram of available nitrogen, part of which will escape into the atmosphere before his crops can use it. Distributing less than one kilogram of urea would add as much nitrogen, though it would do less than the manure for soil tilth... Recommendations that fail to calculate the return to incremental farmers' labor do so at their peril.[22]

If these problems are acute in the highlands region, where population densities are high, they are far more acute in Mid-Africa's lowlands, where labor scarcity is a chronic problem. The hidden costs of labor are even higher in these areas, and they add to the hidden costs of organic fertilizers.

An alternative method of building soil fertility is to practice some kind of a fallow system. According to an FAO summary of fallow practices in Africa, the typical "bush fallow" system restores soil fertility by permitting the regrowth of deep-rooted plants that draw up nutrients from the subsoil. When these plants are cut back, they leave soils that are richer in nutrients; they also add organic materials to the soil to replace those that have been leached away. Fallows and crop rotations also serve to minimize disease and pest problems.[23]

Unfortunately, in many parts of mid-Africa, mounting population pressures have forced farmers to trim the length of fallows on farmland. The FAO concludes that:

> increasing population pressure is hastening the breakdown of traditional fallowing practices ... without compensation for the loss of nutrients by using organic or mineral fertilizers. Consequently, reduction of fallow periods commonly leads to soil erosion rates that are several times faster than the rate of soil formation, and to static or declining yields of staple crops.[24]

Traditional measures thus appear to offer limited potential for increasing soil fertility in mid-Africa. Given the needs for added nutrients to boost crop production, chemical fertilizers must undoubtedly play an important role in strategies for regional agricultural development.

Fertilizer Supply -- Production, Trade and Policy

Sub-Saharan Africa produces virtually no chemical fertilizers. The FAO reports that the region as a whole accounted for 197,000 nutrient tons of chemical fertilizer production in 1983; this represents about one-tenth of a percent of world production.[25] Of the countries in Sub-Saharan Africa, only Zimbabwe ranked as a remotely significant producer of fertilizers as of 1983-84, with a modest domestic output of 115,000 nutrient tons of production. Senegal produced 34,000 tons, mostly for export, and Zambia produced about 16,000 tons of nitrogen fertilizer (N). Of the mid-African countries, Nigeria produced 4,000 tons of phosphate fertilizer (P), while Tanzania produced 9,000 tons of total N+P.[26]

An FAO report concludes that there is relatively limited short-run potential for increasing domestic production of fertilizers. Although a number of countries possess some of the raw materials necessary for fertilizer production, the report states that "they are unequally distributed or difficult to exploit."[27]

As demand for fertilizers increase, and as opportunities for intra-continental trade expand, however, these resources might be increasingly useful. The FAO report notes that 13 countries possess reserves of natural gas; six have oil; and five have coal deposits suitable for nitrogen extraction. Phosphates are found in seven countries, with sulphur and potash each mined in three countries.[28] Lime is found in scattered deposits, and is commercially produced in several countries as a component of cement.

The FAO report judges that for most countries, at present, domestic fertilizer industries would be seriously uneconomical, and that importing supplies currently represents "the most economical short- and medium-term solution."[29]

The IFDC report similarly concludes that the extremely high capital investments and fixed costs required for fertilizer plants, combined with the need to import raw materials and the uncertainties of fertilizer demand, make domestic production implausible for most countries. The authors urge "a great deal of caution" in development of domestic fertilizer industries, and warn that "attempting to provide the farmers with an ample supply of low-cost fertilizer can result in just as serious a drain on national wealth as can a lack of fertilizers."[30]

Domestic production thus offers dubious prospects for most countries to meet their fertilizer needs. Unfortunately, the alternative approaches to supplying fertilizer are also fraught with problems.

As might be expected, given the negligible production of fertilizers in Sub-Saharan Africa, even current low levels of consumption must be supplied through imports. In

fact, for sub-Saharan Africa as a whole, over 90 percent of fertilizer consumption in 1983-84 was supplied by imports.[31] Roughly half of these imports were commercial; half were provided concessionally as development aid.[32]

For financially strapped mid-African nations, however, commercial imports represent a drain of scarce foreign exchange. This has been exacerbated, for many countries, by the steep currency devaluations that accompanied structural adjustment programs during the 1980s. Devaluations increase the local currency cost of fertilizer and other imports.

The foreign exchange problem has been particularly acute in the 1980s, particularly when combined with the widespread currency devaluations imposed in many countries. Of the 11 mid-African countries including Nigeria, nine were running current account deficits in 1986. Six of these countries have experienced persistent balance of payments problems -- meaning that they have run steady current account deficits since 1980.

Leaving aside Nigeria, which skews regional totals by the sheer size of its economy, the remaining ten countries in the region had a combined current account deficit of US$ 3.1 billion in 1986. This figure represents about 8.8 percent of the combined GDP of these countries. (See Table 2.) [33]

Under these conditions, it is easy to understand the strain that any level of fertilizer imports must entail. Whether under fixed exchange rate systems or floating rates (i.e., under any system of allocation of foreign exchange), fertilizer imports are competing with imports of food, machinery, automobiles, luxury goods, and other products. It should come as no surprise that fertilizer import levels are generally inadequate for most of the countries concerned. [34]

The high cost of fertilizer imports to national economies is mirrored by the high cost of fertilizers at the farm level. High world market prices are compounded by high transport costs needed to move bulky fertilizer supplies to farmers in interior regions. The resulting costs often render fertilizer use unprofitable except on high-return cash crops, or in areas easily accessible by modern transport equipment.

A number of governments have responded to these problems by bringing the fertilizer industry under state control. In virtually all the countries of sub-Saharan Africa, state organizations play a large role in fertilizer marketing, sometimes in conjunction with private sector activity. The FAO report, based on 1983 surveys, identifies Kenya as the only mid-African country with private sector fertilizer marketing at unregulated prices.[35]

In most cases, according to the FAO report, African governments have sought to subsidize fertilizer prices paid by farmers -- often by 50 percent or more. The IFDC study cited above notes that for some Asian countries, fertilizer subsidies reach as high as $100 per nutrient tonne.[36] At best, the FAO report argues, these subsidies have proved expensive drains on national government budgets. At worst, they have skewed fertilizer use in unproductive directions and have encouraged wastefulness.[37]

In recent years, at the urging of World Bank and IMF experts, many countries have sought to phase out, cut back or eliminate fertilizer subsidies.[38] Combined with the occasionally steep currency devaluations undergone by many African economies, the cutback in subsidies has contributed to soaring prices for fertilizers. Although accurate data are extremely scarce, FAO data for Zimbabwe indicate that nominal fertilizer prices tripled between 1979 and 1986; more than doubled in Kenya between 1980 and 1985; and more than doubled in Algeria between 1982 and 1985.[39]

In some cases, of course, the liberalization of fertilizer marketing and distribution systems led to greater supplies and more timely distribution. Cameroon, for instance, privatized its fertilizer importation and distribution system. According to at least one observer, private sector traders have provided greatly improved services in supplying farmers with fertilizers at appropriate seasons. Some reports indicate that fertilizer use has increased correspondingly; but it will take time before this becomes clear.[40]

In other cases, fertilizer price rises were offset in part by increasing crop prices -- particularly in those countries where agricultural price liberalization formed a part of structural adjustment packages. But it appears from the same FAO data that in the few African countries for which data are reported, the overall trend in the 1980s has been for farmers' fertilizer costs to rise faster than their output prices.[41]

This suggests that the prospects for increasing fertilizer use in Africa will be linked closely to the ability of countries to find some vehicle for paying for them. As long as the countries must import fertilizers, they must find adequate foreign exchange to pay the bills in hard currency. They also must deal with the problem of marketing the fertilizer to farmers at affordable prices; if farmers are to pay market prices -- including transport costs -- they must get sufficient cash return from their production to meet the local currency cost. Although public sector subsidies appear to be a wasteful and expensive use of scarce resources, there is clearly a public interest in increasing agricultural production. As Jones and Egli note in their report on the highland farming systems of Zaire, Rwanda and Burundi:

> Governments already painfully short of foreign exchange cannot unambiguously welcome the prospect of a new demand for [fertilizer] imports. The Rwandan Minister of Agriculture, when discussing the possibility of having to start importing fertilizer and

> hybrid maize seed with the Mission, noted that it would probably come to importing these or importing food, which would be far more expensive.[42]

The good sense of importing fertilizer rather than food can be seen from a cursory glance at international prices for the relevant commodities. Over the 1980s, urea prices averaged around $150 per metric ton. Rice prices were well over $200 per mt; sorghum prices around $110 per mt; maize around $120 per mt; and wheat around $150 per mt. Since transportation costs for bulk fertilizer are essentially comparable to those for bulk grains, the fertilizer would need to generate yield responses of little more than 1:1 in order to provide savings in foreign exchange.[43] Given this alternative, government support for fertilizer consumption looks less unacceptable.

Fertilizer Use at Farm Level

The ultimate determinant of farm-level fertilizer use is the profitability of fertilizers. Profitability is closely related to the yield responses generated by fertilizer application, but it introduces the element of price. Specifically, the relative prices of fertilizer and crop production will determine the extent to which farmers use fertilizers.

One way of assessing the profitability of a technology like fertilizers is to calculate the "value-cost ratio" (VCR). This is a simple ratio of the value of additional output to the cost of an additional input. FAO has recorded numerous VCRs for the trials the organization has conducted in Africa. Almost without exception, they indicate that fertilizer use can be extremely profitable.

There are problems with these figures, however. It is not always clear whether the VCRs are calculated with market prices or real "shadow" prices; nor whether the prevailing prices are subsidized or not. In many cases, subsidies and other government interventions can have enormous impact on the profitability of fertilizer use.

An additional problem is that conventional fertilizer-use VCRs do not adequately take into account additional costs other than those of the fertilizer. Farmers may face additional costs in travelling to a sale point to buy fertilizer; in transporting fertilizer to their fields; in applying it to fields; and in harvesting and processing added output.

Carr estimates that these additional costs may total as much as 25-33 percent of actual fertilizer costs. He suggests that in many cases, these added costs -- and the high cost of transport -- may make serve to render fertilizer use uneconomical for African farmers. Carr reports data from Nigeria and Ghana that suggest that the

maize prices needed for farmers to make fertilizer use profitable are above comparable import parity prices.[44]

Another factor which influences farm-level fertilizer use is risk. Because fertilizer purchases represent the largest single cash outlay that most farmers will make in a given season, farmers are reluctant to buy fertilizers under conditions of high risk. Particularly in dry areas, or areas with considerable rainfall variability, this plays a major role in determining levels of fertilizer use.

Conclusion

In conclusion, a sound fertilization research and extension program aiming at the conservation of the national patrimony (land resources) and a sustainable agricultural production must research ways to:

- make chemical fertilizers available to, and affordable by farmers;
- promote a more efficient recycling of crop residues;
- promote a more efficient use of livestock and small animals for animal manure production;
- foster the utilization of legumes in crop/soil systems, as in the case of alley cropping;
- ensure that proposed technical packages do not threaten soil conservation efforts; and
- promote a more efficient use of the few local sources of fertilizers (e.g. lime, phosphates...).

FOOTNOTES

1 C. Pieri, "Management of Acid Tropical Soils in Africa," in Management of Acid Tropical Soils for Sustainable Agriculture, proceedings of an IBSRAM Inaugural Workshop, 24 April-3 May 1985, IBSRAM No. 2, pp. 41-61.

2 See, for example, Luciano Borin, "Adapting Fertilizer Technology to the Needs of Sustainable Agriculture: The Role of Organic-Based Fertilizers and Their Applicability to Sub-Saharan Countries," in Contact, a newsletter for the Special Program for African Agricultural Research (SPAAR), No. 4, June 1989, feature article, pp. 4-5.

3 Ibid.

4 N.V. Hue and I. Amien, "Aluminum Detoxification with Green Manures," photocopied paper, Department of Agronomy and Soil Science, College of Tropical Agriculture and Human Resources, University of Hawaii, undated.

5 One reason for the dearth of information on fertilizer responses is that research efforts in Africa have not focused greatly on specifying crop production functions. This stems in part from a disciplinary shift: in the agricultural sciences, single-input response functions no longer seem to comprise a major area of research. Previous work on crop responses dealt relatively little with Africa.

A second reason for the paucity of fertilizer response studies in Africa is that the methodologies have not generally been well suited for the agricultural systems characteristic of the continent. In contrast to the monoculture rice farming systems of Asia, the mixed cropping systems of Africa make it extremely difficult to calculate farm-level crop responses to fertilizers. On-station experiments can offer good data for calculations, but they seem disturbingly irrelevant to actual on-farm conditions.

Other characteristics of African agriculture add to the problems faced by researchers. Poor roads and inadequate transport make it difficult to manage on-farm experiments in remote regions. Pronounced variability in soil types and agroclimatic factors makes it difficult to compare results from region to region.

6 C. Joly, Manager, FAO Fertilizer Programme, "The Role, Activities and Experience of FAI in Fertilizer Development and Adoption in Africa," unpublished paper dated 21 September 1988, made available to Winrock International by FAO, pp. 1-2, 9.

7 Ibid., p. 9.

8 Food and Agriculture Organization of the United Nations, 25 Years -- FAO Fertilizer Programme: 1961-86 (Rome: FAO/FIAC, 1987), p. 74.

9 Ibid.

10 Charles Simkins and William Fenster, "Effect of Nitrogen Fertilizer Applications on Yield of Maize Variety GUSAU-TZB," in Government of Uganda Ministry of Agriculture, 1988 Interim Research Report by the Ministry of Agriculture on Maize, Soybean and Sunflower Trials, unpublished materials made available by Charles Wortmann, CIAT Regional Bean Agronomist for Eastern and Southern Africa.

11 Penning de Vries and de Wit, p. 115.

12 Ibid.

13 A. Bationo, S.K. Mughogho, and U. Mokwunye, "Agronomic Evaluation of Phosphate Fertilizers in Tropical Africa," in Management of Nitrogen and Phosphorus Fertilizers in Sub-Saharan Africa, p. 294.

14 Food and Agriculture Organization of the United Nations, Fertilizer Strategies, FAO Land and Water Development Series, No. 10 (Rome: FAO, 1987), p. 30.

15 M. S. Mudahar, "Fertilizer Problems and Policies in Sub-Saharan Africa," in Management of Nitrogen and Phosphorous Fertilizers in Sub-Saharan Africa, eds. A. Uzo Mokwunye and Paul L. G. Vlek, proceedings of a symposium held in Lome, Togo, March 25-28, 1985, Developments in Plants and Soil Sciences Series No. 24 (Dordrecht: Martinus Nijhoff Publishers, 1986), p. 15.

16 World Bank, World Development Indicators 1987, computer-based economic and social data series to accompany World Development Report 1987. Fertilizer consumption data are provided in Table 7; the tables have been re-arranged, however, to form a component of the Winrock Agricultural Development Data Program. Future citations will refer to such data as "World Development Indicators, via WADDP."

17 Ibid.

18 Mudahar, p. 15.

19 Carl K. Eicher and Doyle C. Baker, Research on Agricultural Development

in Sub-Saharan AFrica: A Critical Survey, Michigan State University International Development Paper No. 1 (East Lansing, Michigan: MSU Department of Agricultural Economics, 1982), p. 125.

20 Mudahar, p. 15.

It is important to note, however, that FAO estimates tend to suggest the opposite. According to tables prepared by the FAO, only 26 percent of fertilizer use in Africa was applied to "exports and non-food crops." The remainder is supposed to have gone on food crops. It is not clear from table documentation which crops are included in the two categories, or on what evidence these estimates are based (the source cited is "national and FAO estimates"). FAO does acknowledge that fertilizer use per hectare tends to be far higher for export crops, with 5 kg/ha average for Sub-Saharan African food crops versus 32 kg/ha for exports and non-food crops.

See, for further details, Food and Agriculture Organization of the United Nations, African Agriculture: The Next 25 Years, Annex V: Inputs supply and incentive policies (Rome: FAO, 1986), Table 9, p. 105.

21 William I. Jones and Roberto Egli, Farming Systems in Africa: The Great Lakes Highlands of Zaire, Rwanda, and Burundi, World Bank Technical Paper Number 27 (Washington, DC: The World Bank, 1984), pp. 76-77.

22 Ibid.

23 Food and Agriculture Organization of the United Nations, African Agriculture: The Next 25 Years, Annex III: Raising Productivity (Rome: FAO, 1986), p. 5.

24 Ibid., p. 5.

25 FAO, Annex V: Inputs Supply and Incentive Policies, Table 10, p. 106. See also, D.H. Parish, "The Role of Fertilizers in Increasing Food Productivity in Developing Countries," in Rendiconti della Accademia Nazionale delle Scienze Detta Dei XL, Memorie di Scienze Fisiche e Naturali, Estratto, Serie V, Vol. XI, Parte II, Paper Presented at the International Meeting "Towards a Second Green Revolution: From Chemical to New Biological Technologies in Agriculture in the Tropics," held in Rome, 8-10 September, 1986 (Rome: Accademia Nazionale delle Scienze, 1987), p. 283.

26 FAO, Annex V: Inputs Supply and Incentive Policies, Table 10, p. 106.

27 FAO, African Agriculture: The Next 25 Years -- Annex V: Inputs Supply and Incentive Policies (Rome: FAO, 1986), p. 23. See also J.J. Schultz and D.H. Parish, Fertilizer Production and Supply Constraints and Options in Sub-Saharan Africa, unpublished working paper (Muscle Shoals, Alabama: International Fertilizer Development Center, April 1989), p. 13.

28 FAO Annex V, p. 23.

29 Ibid.

30 Schultz and Parish, pp. 1, 26.

31 Ibid.

32 Ibid., p. 23.

33 World Bank, World Tables 1987 (Washington, DC: The World Bank, 1988), assorted country tables.

34 Where governments are allocating foreign exchange, politically powerful sectors tend to gain disproportionate access to scarce hard currencies. This may include large commercial farms, which use fertilizer for plantation-type agriculture. Small farmers will seldom have sufficient political clout to encourage governments to devote large chunks of hard currency to purchases of fertilizer.

In a market-oriented system of foreign exchange allocation, prices of imports will be bid up to a point where demand for imports meets the supply of hard currency. Because small farmers have limited effective demand, they cannot outbid competitors from other sectors of the economy. Small farmers will have limited ability to purchase imports under such conditions.

35 FAO, Annex V, p. 39.

36 Schultz and Parish, p. 22.

37 Ibid.

38 For discussions of the World Bank's activity in structural adjustment programs, and for discussion of the design of such programs, see:

The World Bank, Financing Adjustment with Growth in Sub-Saharan Africa, 1986-90 (Washington, DC: The World Bank, 1986).

Also, The World Bank, Country Economics Department, Adjustment Lending: An Evaluation of Ten Years of Experience, Policy & Research

SEries Number 1 (Washington, DC: The World Bank, 1988).

And finally, Bela Balassa and F. Desmond McCarthy, Adjustment Policies in Developing Countries, 1979-83: An Update, World Bank Staff Working Papers Number 675 (Washington, DC: The World Bank, 1984).

39 Food and Agriculture Organization of the United Nations, FAO Yearbook of Production, 1987, Volume 41 (Rome: FAO, 1989), Table 132, pp. 342-43.

40 Personal communication from Dr. J.A. Ayuk-Takem, Director, Institut de la Recherche Agronomique, Republic of Cameroon.

41 Ibid.

42 Jones and Egli, p. 78.

43 Commodity price data are generated from figures in the International Monetary Fund, International Financial Statistics, 1988 Yearbook (Washington, DC 1988), pp. 181-83.

44 Stephen J. Carr, "Technology for the Major Food Crops of Sub-Saharan Africa: A Synthesis of World Bank and Other Experiences in Five Major Ecological Zones," unpublished paper, dated July 19, 1989, pp. 36-39.

CHAPTER 5

IRRIGATION IN MID-AFRICA

Introduction

This chapter is a condensed and revised version of a paper presented at a World Bank workshop on "Private Sector Irrigation in Africa" (June, 1989). Much of the material for this paper was prepared under this study. The focus on private-sector irrigation neglects the large, publicly owned and operated systems. However, one of the major lessons of irrigation development in Asia and elsewhere is that small, private-sector irrigation systems should be developed first, before large systems are undertaken. Small systems are generally less expensive per hectare of irrigated areas, and they provide better irrigation quality, with correspondingly higher irrigation benefits. In any case, most of Sub-Saharan Africa is more suited to small-scale pump and water-harvesting irrigation systems than to large systems.

Four Principles

In considering private sector irrigation in Mid-Africa, four basic principles should be kept in mind.

Returns to Investment. Private-sector irrigation depends on the private, financial return to investment in irrigation. While a favorable return is not a sufficient condition for private-sector investment in irrigation, it is a necessary condition. In contrast, for public-sector irrigation, the final criterion is social costs and benefits. Although private sector irrigation may also be evaluated by this standard, private-sector investment cannot always be directed towards socially desirable activities such as irrigation. Promoting socially valuable private-sector activity is the real meaning of "getting prices right", and it is not an easy thing to do.

Environment for Irrigation. The return to investment in irrigation is largely determined by the physical, social, and economic environment of irrigation. Six environmental conditions must be satisfied for feasible private-sector irrigation.

- Conversion of rainfed agriculture to irrigated agriculture must sufficiently increase agricultural production to justify additional costs of irrigation.

- A supply of good quality water and irrigable land must be within reasonably close to each other.

- Irrigation requires a reliable and economical supply of other inputs such as improved seeds, fertilizers, and labor to realize its productive potential.

- An economically accessible market must be available for purchase of these and related inputs and for sale of marketable surplus from irrigated areas.

- Because of these reasons, a reasonable transportation system must exist between the irrigated area and market centers.

- Producer input/output prices must be "right," and reasonably stable over the life of the irrigation investment.

In many places in Africa, these conditions are not adequately satisfied in the irrigation environment.

The best example of the importance of the irrigation environment can be found in the most successful case of private-sector irrigation in developing countries: private-sector tubewell irrigation in India, Pakistan, and Bangladesh.

In these countries, private tubewells have flourished in areas with reasonable roads, research and extension systems, crop price support programs, credit and (usually) subsidies for irrigation equipment, fertilizers and energy. In addition, private tubewells have largely developed in and around the command areas of large surface irrigation systems.

There are three reasons for this. First, deep percolation losses from the surface systems recharge the aquifers for tubewells. Second, the tubewells are often used together with surface irrigation water, which lowers pumping costs and concentrates these costs in periods of highest marginal returns. Third, the tubewells piggy-back on the infrastructure created for the surface systems.

Most problems of irrigation in Sub-Saharan Africa are not problems of irrigation, but problems of the environment of irrigation.

Distinctions Between Public and Private. In discussing irrigation, we must be cautious in using the phrase, "private-sector irrigation." If we restrict this concept to include only individually owned and operated systems, we restrict technological and institutional options available to us. Given the small size of farms in Africa, only pump irrigation technology is sufficiently divisible to be wholly owned and operated by an individual farmer. This technology is restricted to land over aquifers and along the

banks of rivers and lakes. While this kind of small-scale, individually owned and operated irrigation system is nearly ideal, it has only limited scope for realizing Africa's irrigation potential.

Other irrigation technologies are "public goods" in the sense of joint production functions: the same resource is used by more than one individual. This public-good property has naturally led to ownership and management of irrigation systems by public agencies. Some public irrigation systems perform exceptionally well, for example the vast warabandi system of NW India (Seckler, et. al., 1988; Malhotra, 1982), while many perform very poorly. However, between the purely public and the purely private lie a variety of non-governmental, intermediary institutions, both of a commercial and philanthropic nature, that hold great promise for development of private-sector irrigation in Africa.

Growth Centers. The generally unfavorable irrigation environment in Africa confirms the need for a growth-centers strategy for irrigation development, as discussed in Chapter 2.

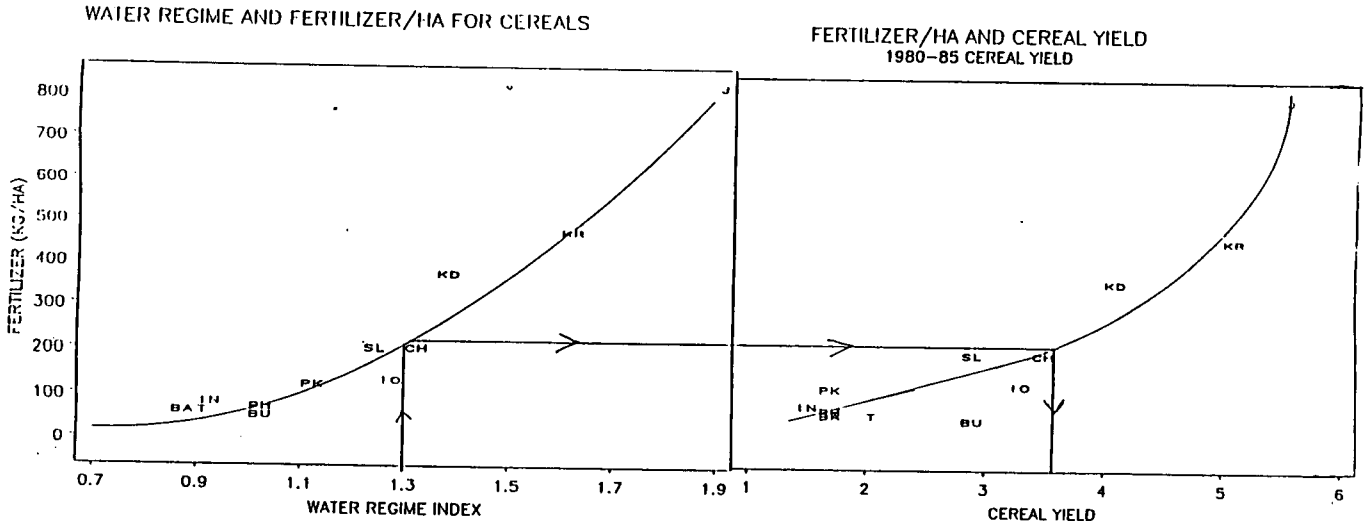
In this approach, specific areas in Africa would be selected as irrigation-based growth centers. Selected first would be the easiest areas with high irrigation potential that already have a reasonable infrastructure of roads, markets, and input supplies. After these first-order growth centers are well on the way to development, and the lessons on how to develop them have been learned, new second-order centers would be established out a hundred kilometers or so in more backward areas.

The first and second order growth centers would be connected by transportation and communication facilities. In this way, the growth centers would develop symbiotic trade relations, and these relations would stimulate growth in the areas between the centers. Subsequently, third-order growth centers would be established farther out in the hinterland, and eventually the process would continue all the way across Mid-Africa.

The Synergism Between Irrigation and Other Factors of Production

Irrigation is not a stand alone technology. While it permits high levels of agricultural production by relaxing the constraint of water stress on crops, it requires increased fertilizers, good germplasm, increased labor, and other inputs to realize its potential. If these inputs are available, and other conditions such as prices are favorable, they will induce investment in irrigation in order to realize the high returns generated by the complete package of inputs. Thus, irrigation induces use of other inputs, and other inputs induce use of irrigation in a highly synergistic process of agricultural development.

Figure 1



Japan (J)

Republic of Korea (KR)

Burma (BU)

Philippines (PH)

India (IN)

Korean Democratic Republic (KD)

Indonesia (IO)

Bangladesh (BA)

Nepal (N)

China (C)

Sri Lanka (SL)

Thailand (T)

Pakistan (PK)

This synergistic process is evident from data for 13 Asian nations shown in Figure 1. In the left quadrant of Figure 1, fertilizer consumption is shown in relation to a "water regime index," which, as explained below, is an index of the soil moisture regime established by precipitation and irrigation. The right quadrant shows the relationship between fertilizer consumption and cereal yield. (The upward sloping curve reflects diminishing physical productivity of fertilizer.) Variations in the water regime largely account for variations in fertilizer use, and that variations in fertilizer use, in turn, largely account for variations in yield among the countries. Similar relationship would hold in Mid-Africa.

Irrigation Needs and Potential in Africa

Map 1 in Chapter 2 and Map 2 (FAO, 1987) provide a broad picture of irrigation needs and potential in Africa. Map 1 shows the agroclimatic zone of Africa suitable for maize and other cereal crops under rainfed conditions. The blank areas cannot grow crops without irrigation. This map also shows the rather large area where irrigation is not required under rainfed conditions. However, nearly one-half of this area is in the central rainforest, most considered not suitable for crops in any case. Thus, contrary to the irrigation myth, most of the area suitable for rainfed crops in Africa requires irrigation according to the maps.

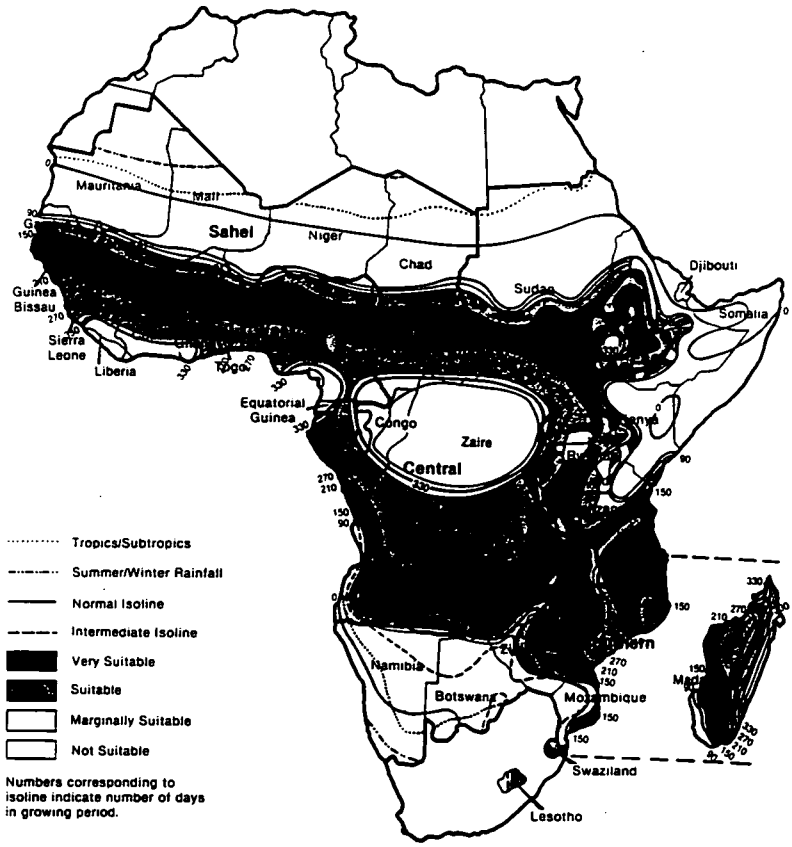
Map 2 shows areas of Africa where varying percentages of the irrigable land have sufficient water to be irrigated. This map is encouraging: much of the area that needs irrigation can be irrigated. Actual water availability may, in fact, be substantially underestimated because of a hidden property of irrigation systems only recently appreciated in irrigation in Asia.

This map is based on the assumption that only 50% of the available water is beneficially used for irrigation and that the rest is lost to surface drainage or deep percolation losses. However, this water is lost only in the first iteration of the irrigation system. In following iterations, the water can be picked up from downstream subsurface flows, or pumped up from aquifers, and reused for additional irrigation. Thus, while every part of the irrigation system may be performing at low efficiency, the system as a whole can converge to very high efficiency. Because of water recycling, irrigation potential may be considerably higher than Map 2 suggests.

Map 1

MAIZE: RAINFED PRODUCTION

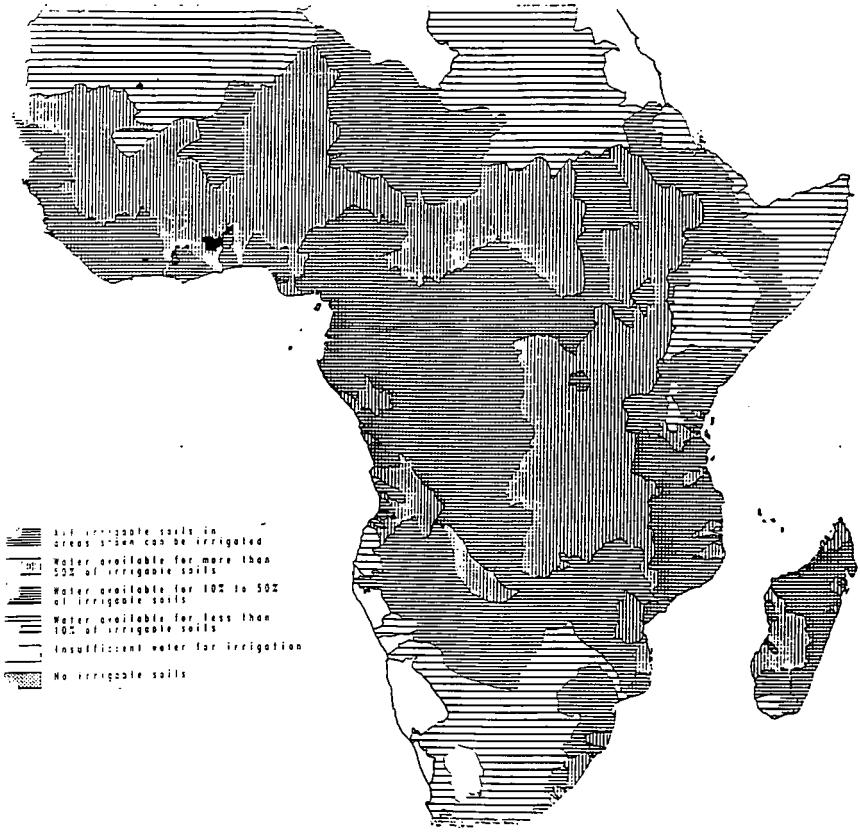
Sub-Saharan Africa



South Africa obviously is part of Sub-Saharan Africa. Unfortunately comparable information was not available to add to this map created by the U.S. Department of Agriculture.

Source: U.S. Department of Agriculture. Foreign Agricultural Research Report No. 168. *Food Problems and Prospects in Sub-Saharan Africa: The Decade of the 1980's.*

Map 2


All irrigable soils in areas where can be irrigated
Water available for more than 50% of irrigable soils
Water available for 10% to 50% of irrigable soils
Water available for less than 10% of irrigable soils
Insufficient water for irrigation
No irrigable soils

There is also the slightly paradoxical problem, apparent on Map 1, that areas "suitable," or even "very suitable," for maize and other crops under rainfed conditions nevertheless do not always fit in the category where irrigation is not required. What this apparently means is that, while in some areas irrigation is not required (in the sense that it would give very little, if any, production response), other areas are suitable for rainfed crops and would also would benefit substantially from irrigation. This problem brings out the fact that the suitability or unsuitability of areas cannot be meaningfully defined in absolute terms. Rather, it must be defined in terms of a continuum of greater or lesser productivity of specific crops under varying conditions of water availability. Since the return to investment in irrigation largely depends on the difference in agricultural production between rainfed and irrigated conditions, these differences must be defined rather closely, as illustrated in the next section.

Water Deficiency Factors

Buringh, van Heemst, and Staring (1975; henceforth, "BHS") estimated soil and water deficiency factors that can be used in preliminary evaluations of agroclimatic areas suitable for rainfed and irrigated agriculture (Seckler and LaBore, 1988). Very briefly, the water deficiency factor (WDF) indexes the probability of loss of economically optimal annual crop production in a given agroclimatic zone due to water constraints. If WDF = 1.00, there is no expected loss due to water constraints; if WDF = 0.50, expected annual crop production could be economically doubled with perfect irrigation, and so on. BHS have also estimated a soil deficiency factor (SDF) by the same process. Since one of the major functions of soil is to hold water, this constraint generally is not so severe for irrigated as for rainfed areas.

The WDF of an agroclimatic zone can estimate whether it pays to convert from rainfed to irrigated agriculture or not. For example, speaking very broadly, private-sector pump irrigation systems must yield an expected net additional return per ha per crop of around 30% before it is feasible. This implies a gross return, or additional yield, of around 40%. Thus, irrigation is likely to be feasible where, at the upper bound, WDF is less than 0.60.

There is also a lower bound for WRI under most conditions. With the exception of large river or storage/canal systems, local irrigation projects largely depend on local precipitation for water supply and therefore the area should not be too dry. Also, pump irrigation costs vary with the amount pumped, so it is better to supply only a portion of crop water requirements, in the periods where irrigation is most productive, by pump irrigation. Thus, areas with a WDF below 0.30 are likely to be too dry for local systems. Following these guidelines, an approximate idea of areas most suitable for irrigation development in Africa can be obtained.

Map 3 shows agroclimatic zones from the BHS study for Africa -- and map 4, for purposes of comparison, for Asia -- with the accompanying deficiency factors for these zones. Zone B4 occurs both in the northern part of Mid-Africa and in the highly productive area of northern India.

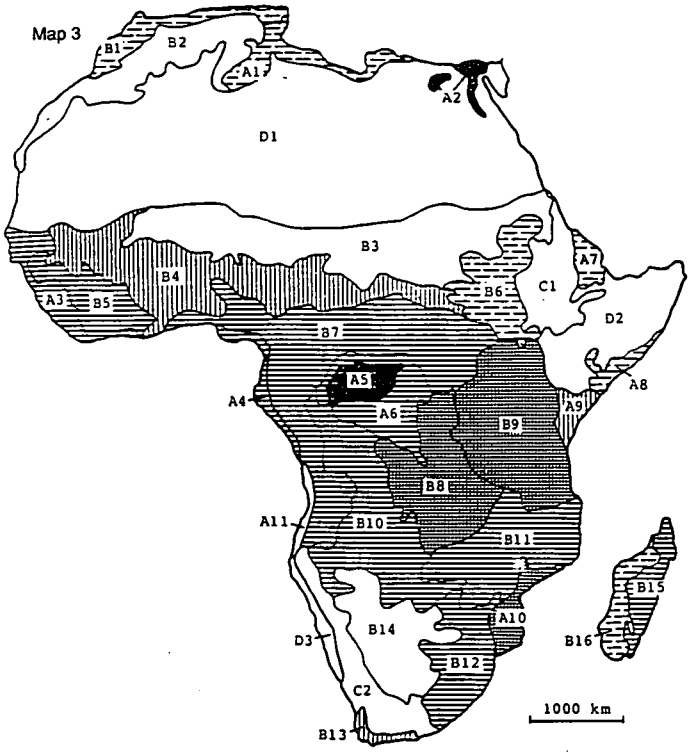
Map 5 shows the areas in Africa where the FWD is between 0.61 and 0.29, and the soil deficiency factor also is favorable. These are the must suitable areas on the basis of productivity of irrigation. Map 2 indicates that, in most of these areas, water is available for more than 50% of the irrigable land. Recognizing the very rough nature of these large-scale agroclimatic zones, these areas appear most suitable for irrigation development in Africa.

Last, Table 1 (FAO, 1987, Table 3) shows irrigated areas and potential for irrigation by countries in sub-Saharan Africa. This study indicates that there is over 33 million ha of potential irrigation in sub-Sharan Africa. Some of this potential exists in areas where irrigation is not needed or feasible. The largest potential for irrigation is in Angola. The countries of Mid-Africa contain 36% of the total irrigation potential of Sub-Saharan Africa.

Irrigation Cultures, Technologies, and Institutions

There is a large menu of irrigation technologies to choose from, each appropriate for different agroecological and other conditions, and each requiring its own kind of institutional structure for managing the system. These institutions may or may not be compatible with local cultures and their adaptabilities. Thus, design and evaluation of irrigation systems should proceed through a three-staged process. The process begins with the physical and cultural factors of the irrigation environment. These factors set the design parameters of the system. The next stage is to define the technological and institutional options available within the design parameters. Last, economic, environmental, social and other evaluations are used to choose the optimal irrigation system from these options.

The following discussion draws on experience with irrigation technologies and institutions in India because India arguably has more experience with a greater variety of irrigation systems, especially private-sector systems, than any other country. What has been learned in India, both pro and con, can be used in developing irrigation in Africa.



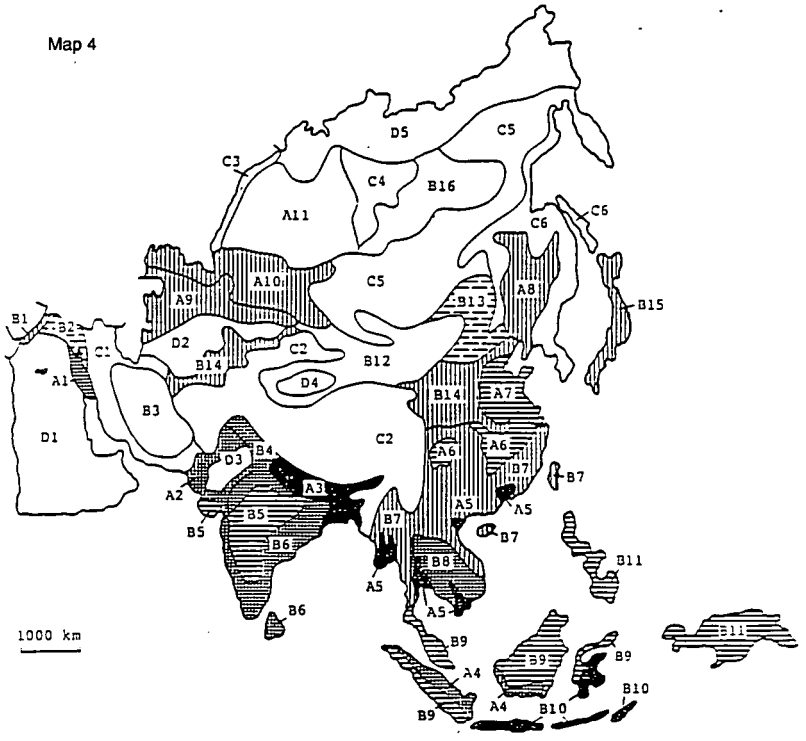
	SDF	WDF
A1	.7	.2
A2	.9	0
A3	.5	.6
A4	.6	.8
A5	.8	.9
A6	.5	.8
A7	.4	.1
A8	.6	.2
A9	.7	.4
A10	.7	.6
A11	.5	.1

	SDF	WDF
B1	.7	.2
B2	.4	.1
B3	.5	0
B4	.6	.3
B5	.6	.6
B6	.5	.1
B7	.5	.7
B8	.6	.7
B9	.6	.6
B10	.5	.5
B11	.6	.5
B12	.6	.6
B13	.6	.4
B14	.5	.1
B15	.5	.7
B16	.8	.2

	SDF	WDF
C1	.7	.5
C2	.7	0

	SDF	WDF
D1	-	-
D2	-	-
D3	-	-

Map 4



	SDF	MDF
A1	.8	0
A2	.7	0
A3	.9	.7
A4	.6	.9
A5	.9	.8
A6	.8	.9
A7	.9	.5
A8	.9	.7
A9	.6	0
A10	.9	.6
A11	.5	.9

	SDF	MDF
B1	.8	.2
B2	.7	.1
B3	.6	0
B4	.7	.3
B5	.5	.3
B6	.6	.6
B7	.5	.9
B8	.7	.6
B9	.5	.9
B10	.7	.8
B11	.5	.8
B12	.6	0
B13	.7	.3
B14	.8	.5
B15	.7	1.0
B16	.4	.9

	SDF	MDF
C1	.6	.1
C2	.6	.1
C3	.6	.9
C4	.6	0
C5	.6	.9
C6	.6	.9

	SDF	MDF
D1	-	-
D2	-	-
D3	-	-
D4	-	-
D5	-	-

10

Major Areas for Irrigation Development

Map 5

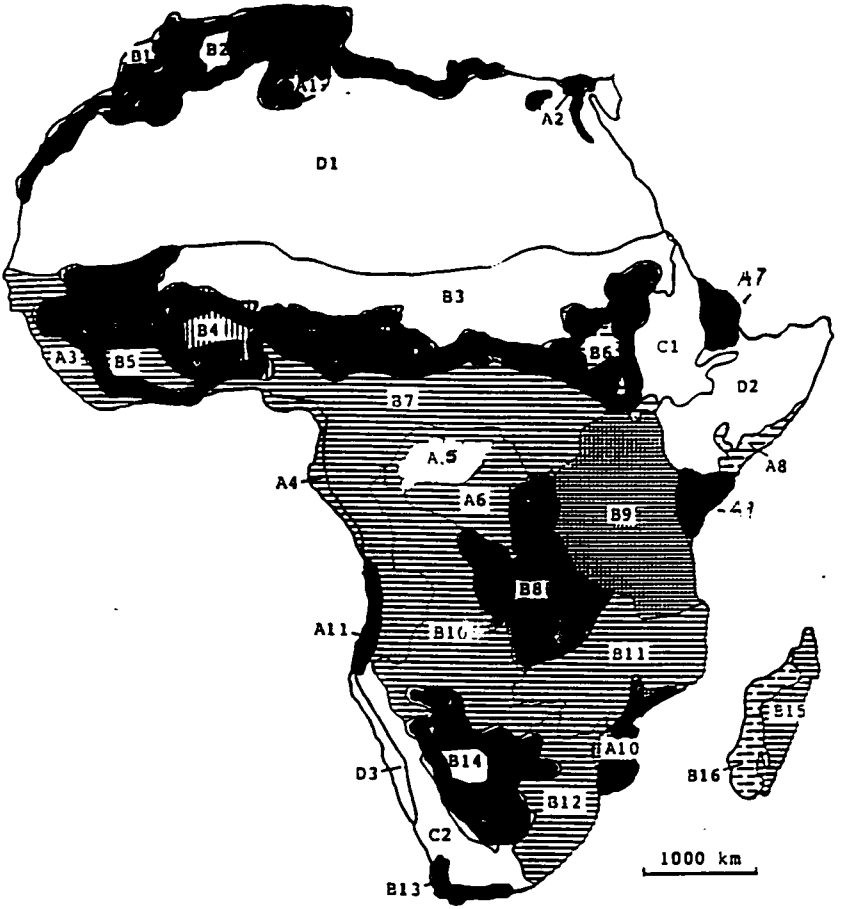


Table 1

Sub-Saharan Africa: Estimates of Irrigated Areas, 1982, in Relation to Irrigation Potential

Country	Irrigation Potential ('000 ha)	Area Developed 1982 ('000 ha) Modern	Small-scale or Traditional	Total	Developed as % of Potential
Angola	6,700	0	10	10	< 1
Benin	86	7	15	22	26
Botswana	100	0	12	12	12
Burkina Faso	350	9	20	29	8
Burundi	52	2	50	52	100
Cameroon	240	11	9	20	8
Central African Republic	1,900	0	4	4	< 1
Chad	1,200	10	40	50	4
Congo	340	3	5	8	2
Equatorial Guinea	n.a.	n.a.	n.a.	n.a.	n.a.
Ethiopia	670	82	5	87	13
Gabon	440	0	1	1	< 1
Gambia	72	6	20	26	36
Ghana	120	5	5	10	8
Guinea	150	15	30	45	30
Guinea Bissau	70	n.a.	n.a.	n.a.	n.a.
Ivory Coast	130	42	10	52	40
Kenya	350	21	28	49	14
Lesotho	8	0	1	1	13
Liberia	n.a.	3	16	19	n.a.
Madagascar	1,200	160	800	960	80
Malawi	290	16	4	20	7
Mali	340	100	60	160	47
Mauritania	39	3	20	23	59
Mauritius	n.a.	9	5	14	n.a.
Mozambique	2,400	66	4	70	3
Niger	100	10	20	30	30
Nigeria	2,000	50	800	850	43
Rwanda	44	0	15	15	34
Senegal	180	30	70	100	56
Sierra Leone	100	5	50	55	55
Somalia	87	40	40	80	92
Sudan	3,300	1,700	50	1,750	53
Swaziland	7	55	5	60	>100
Tanzania	2,300	25	115	140	6
Togo	86	3	10	13	15
Uganda	410	9	3	12	3
Zaire	4,000	4	20	24	1
Zambia	3,500	10	6	16	< 1
Zimbabwe	280	127	3	130	46
Total	33,641	2,638	2,381	5,019	14.9

Sources: Study team estimates of areas developed; irrigation potentials from FAO Land and Water Division, 1985 (provisional estimates).

Culture

The very real "culture of irrigation" is not compatible with every other culture. People from pastoral cultures, for example, have to undergo a very difficult process of adjustment, a basic change in life styles, to adjust to the culture of irrigation. However, the cultural factor cannot be dealt with in generalities; it depends on cultural specifics, and even on differences between individuals within the same culture. One of the most gratifying, and even surprising, features of the World Bank-sponsored **Semry Rice Project** in Cameroon (World Bank, 1984) is how readily local tribal people adapted, learned, and prospered under irrigated agriculture. Other cases probably could be cited where irrigation failed because of cultural constraints, although they are not easy to find. The cultural factor is of greater importance in the design of the management system for irrigation, which also affects the design of the physical system. Some cultures are more communal in nature while others more individualistic. Systems can and should be adapted to these cultures -- rather than, as is too often the case, attempting to adapt cultures to irrigation systems.

There is little more to be said in general on the subject of the culture of irrigation except to emphasize the crucial importance of having professionals from the local culture, as well as local people, decisively involved in all stages of irrigation design and implementation. There is no question, for example, that the very successful "Sukhomajri" project in India, discussed below, would have failed had this principle not been religiously followed.

Technologies

The major irrigation technologies are composed of combinations and permutations of four basic components of irrigation systems. These are:

- the source of the water supply
- the motive force to control the water
- the conveyance system from the source to the irrigated area
- the application system that applies water to the crop.

These components and their sub-components are listed, roughly in increasing order of cost and technical sophistication, in Table 2.

130-597 - 0 - 90 - 12

Table 2. Alternative irrigation technologies.

A. Source of water supply
1. Aquifers
2. Small water-harvesting tanks
3. Rivers and lakes
4. Large reservoirs
B. Motive force
1. Gravity
2. Pumps
3. Barrages
4. Animal or human power
C. Conveyance systems
1. PVC pipes
2. Canals and channels
Lined
Unlined
D. Application systems
1. Flood, furrow, etc.
2. Sprinkler
3. Drip

An indication of the variety of irrigation systems that can be generated from these components is shown in Keller (1989), where over 20 systems are identified on the basis of the conveyance and application characteristics alone.

Institutions

Various institutional arrangements exist for financing, constructing, operating, maintaining, and using irrigation systems.

These institutions depend on who owns and/or manages the system, and how they relate to the ultimate user of the system, usually the private farmer, in relation to the four components of the irrigation system of Table 2. Four basic institutional models may be involved in any or all of the technical components of the system:

- Individually owned and operated systems

- Market systems
- Water users associations
- Government agencies.

As a general policy, it is best to undertake the least costly and sophisticated technological and institutional systems first--to stay as high up on these lists as possible, until it is necessary to go lower down the list. This rule leads to the most promising irrigation systems for Africa: (a) pump irrigation systems, where water is available through aquifers, rivers, and lakes; and (b) water harvesting tanks in hilly areas with reasonably high but erratic levels of precipitation. These technologies also are compatible with the most effective institutional arrangements: individual ownership, water markets, and water users associations.

Pump Irrigation Systems

As noted before, pump and lift systems are the only irrigation technologies sufficiently divisible to be owned and operated by a small farmer. However, this model depends on pumping or lifting water to land adjacent to rivers, lakes, and aquifers and is, therefore, limited to areas where these resources exist.

Before proceeding further with the discussion on pump irrigation, it is necessary briefly to discuss human or animal-powered lift systems. While these are often considered to be appropriate technologies, they have only a very special and limited niche in irrigation. This niche is where only small quantities of water have to be lifted short distances on an occasional basis to avoid temporary moisture stress of crops. The reason why these lift systems have such limited scope is that the human or animal energy expended in lifting water is so costly. An adult male, using efficient manual pumps, requires about five days of labor to lift as much water as would be lifted by one liter of diesel fuel in a small diesel engine. An ox can lift 3 to 5 times as much as an adult male, or as much as a liter of diesel in 1 to 2 days of work. Unless the marginal productivity of the water is extremely high, as it is in temporary droughts, more calories can be used up in human or animal energy than produced by irrigating the crops.

Small, farmer-owned pump systems often evolve into a market system where pump owners use the surplus capacity of their pumps to water their neighbors' crops. Throughout the Asian subcontinent, from Pakistan through India to Bangladesh, with lifts (total dynamic head) of around 10 meters, water is typically sold for one-quarter to one-third of the crop harvest.

Bangladesh has been particularly innovative in promoting pump irrigation systems for small farmers. Farmers can rent pumpsets from state agencies seasonally or annually. Also, NGOs have helped groups of landless laborers purchase portable

pumpsets, usually mounted on an ox cart. Farmers then pay "rent" to the groups for pumping water. Efforts are being made in Bangladesh to encourage private enterprises to provide rental pump services--like household equipment rental shops in the United States, perhaps under franchise arrangements. These companies may also rent small tractors and other equipment to farmers.

Another model is where NGOs develop and manage pump irrigation systems for farmers. One of the more successful areas in which this model has been followed is in Maharastra, India. There, government agencies and sugar cane factories finance NGOs for development of large-scale pump irrigation systems covering several hundred hectares of land. The NGO builds and operates the system and collects water charges from farmers for debt service, operation, and maintenance expenses. One of the keys to the success of this model is an assured supply of low-cost electricity for the pumps.

Last, pump irrigation systems are readily adaptable to PVC pipe conveyance systems, further discussed below, and to sprinkler and drip irrigation, where pump pressure is usually necessary. Sprinkler and drip systems depend on very high quality, clean water, mainly from aquifers. These systems are best suited for high-valued crops, very scarce water supplies, hilly land, pervious soils, and where there are labor and management constraints. For larger farm areas in the 125 to 300 acre range, center pivot irrigation may be suitable in parts of Africa. A private sector/IFC feasibility study in Kenya, for example, found that it would be feasible to install over 20,000 acres of center pivot irrigation for maize production. With reasonably planned crop systems, center pivots also could provide many small farmers with controlled rain. All forms of sprinkler and drip systems, as well as pump systems, require an infrastructure of parts and service facilities, which limits their use in very underdeveloped areas.

Engineering and Economic Aspects of Pump Irrigation Systems

With lifts on the order of 10 meters and energy costs close to world market prices, pump irrigation is the most economical form of irrigation system. Part of the reason this fact is not more generally appreciated is that it is not easy to calculate the engineering and economic aspects of pump irrigation systems under varying conditions. This section draws on results of a micro-computer based model of pump irrigation systems that has been applied to case studies in Senegal and Botswana (Seckler, et. al., 1988), as well as in several Asian countries. Given basic data inputs, the model computes irrigation requirements for various crop rotations, sizes the pumpset, computes energy use and calculates economic returns. As is almost always the case, the major data problems are in determining producer prices of inputs and outputs and expected increases in production under irrigated conditions. While the figures used in the following case studies are the best that could be obtained under

the circumstances, they are necessarily subject to detailed review and revision. Only a brief review of the major findings of the simulations are discussed here.

Senegal: Dispersed Diesel Pumpsets

This case study is based on a study of lift irrigation in Senegal by Perlack et. al. (1987). The irrigation system is designed for pumping from the Senegal River to irrigate 400 ha, with two crops pa--sorghum and rice, resulting in a gross irrigated area of 800 ha. Sixteen pumpsets are used, each irrigating a net area of 25 ha, here called the unit command area (UCA). Three alternative energy systems for irrigating this area were evaluated: (a) dispersed 25 kw diesel pumpsets; (b) electric pumpsets, with energy provided through a "mini-grid" from two 280 kw diesel generating sets (gensets); and (3) irrigation from two large diesel pumpsets.

Table 1 shows the summary (the "Driver") pages from the irrigation energy model. The study by Perlack et. al. concentrates on the costs of the irrigation systems, with no information on agricultural costs and returns. The figures for "Net Crop Revenue" in table 1 are therefore based on rough FAO (1987) estimates that indicate returns of $300 to $400 per ha pa (with two crops a year) in sub-Saharan Africa.

As shown in Section B of Table 1, the model calculates the annual energy costs, the present value of the total costs per ha of gross irrigated area (GIRRA), the benefit-cost ratio, and the internal rate of return of the system over a life of 25 years. This period was chosen to make lift irrigation systems more directly comparable to gravity irrigation systems.

The present value of the total costs of this system is $1,604 per ha of GIRRA. This is only about one-half of the cost of a medium-size gravity irrigation system in India, and an even smaller percentage of a typical gravity system in Africa. A benefit-cost ratio of 1.13 and an internal rate of return of 19% make this project economically feasible.

Senegal: Large Diesel Pumpsets

The simulations showed that the electrical, "mini-grid" system was not economically feasible. However, an alternative approach is to use fewer but larger diesel pumpsets. Whether or not this idea is feasible in terms of the layout of the country or in terms of the organizational and managerial factors is not known. However, if net crop revenue remains the same, the economic benefits of a lift irrigation system increases with size because of economies of size in unit costs of equipment and to increased energy efficiency of engines.

The model estimates that two 140 kW pumpsets would irrigate this area. The conveyance efficiency in the unit command area is reduced from 100% in the previous

case to 80%, due to longer length of conveyance through earthen channels. The model could be used to explore the feasibility of lining canals or pipe conveyance systems to save conveyance losses (and sprinklers to save application losses), but this has not been done. The economic benefits of this model improve dramatically over the previous one, with the benefit-cost ratio increasing to 2.38 and the internal rate of return to a rather fabulous 127%.

Senegal, Public Utility Company Model: Large Diesel Pumpsets

Although the potential returns to large pump systems is greater than small systems, there are substantial problems of financing, and managing these large systems and delivering water supplies to many different farmers. A possible solution to this problem is to create a publiciy regulated, private sector company to develop the irrigation system and sell water to farmers. This "public utility company" model is discussed further below. The purpose here is to see how the economics of this model, based on the two large diesel pumpsets discussed above, would work out.

One of the basic questions is how to charge for the water delivered to farmers. The best way would be to charge on a volumetric basis of so much per hectare meter, or acre foot. However, unless there is a pipe conveyance system where the volume actually delivered per unit of time can be accurately estimated, this is very difficult (it is impossible to prove that the amount of water delivered within a reasonable margin of error due to variations in conveyance losses at different delivery points). As a second best alternative, the utility company could charge on a per crop per season basis, with the charge varying in correspondence with the volumetric irrigation requirements of the crop. This would induce farmers to grow more water-efficient crops in relation to crop returns. This is the charge basis assumed here, although the price per unit of water also is easily computed through the model.

It is assumed that the irrigation charge for sorghum is $75 per ha and $25 per ha for rice (because of the greater dry season irrigation requirement of sorghum). The model shows that at these prices the farmers would receive slightly higher net returns from their crops than they would under the dispersed pumpsets model, and the public utility would realize a benefit-cost ratio of 1.25, or an internal rate of return of 27%. Clearly all parties would gain in this model. This example shows the enormous loss in terms of technical efficiency that accompanies the managerial efficiency of small pumpsets. However, when pumping from aquifers, large pumpsets have substantial diseconomies of size in terms of higher lifts due to the cone of depression of the water level in the aquifer.

Senegal, Alternative Pump Energy Systems

The model has been used to examine the possibility of substituting some of the expensive diesel fuel with producer gas made from wood chips or similar biomass materials. Although the technology and reliability of producer gasification will not be dealt with here, (see Foley and Barnard 1983; and Seckler, 1984), it is reasonably assumed that gasification can replace 65% of the diesel fuel at a conversion rate of 3.2 kg of air dried wood per liter of fuel replaced. The wood is assumed to cost $50 per metric ton, delivered to the site and chopped into the appropriate sizes. This price is sufficient to yield a favorable return on woodlots under most conditions. The gasification units cost $100/kw of capacity and last for 20,000 hours of operation with reasonable maintenance. In this application, the gasification unit yields a benefit-cost ratio of 1.55 and an internal rate of return of 18%.

Last, the costs of solar cells appear to be decreasing to the point that they may be feasible energy sources for pump irrigation in the next few years. The cost of electricity through a diesel genset is about $0.15 kWh. According to Hubbard (1989) electricity can now be produced by photovoltaics at a cost of $0.30/kWh, and new plants are on stream to reduce costs to $0.15/kWh. It is not clear that these are total system costs, which are about twice the cost of the photovoltaic cells. If they are total system costs, this is a viable technology for supplemental pump irrigation in remote areas of developing countries. These units have a virtually maintenance-free life of 20 years. Thus a one-time subsidy of around one-half the capital costs may bring the costs of solar energy into a practical domain for private sector irrigation. Of course both wood gasification and solar energy technologies become more economical when petroleum has to be imported, and the shadow price of foreign exchange is high.

Botswana: Diesel Pumpsets

The model also has been used to simulate pump systems in Botswana.

The study by Perlack et. al. (1987) is based on small tubewells with unit command areas of 4 ha and an operating head of only 3 meters (compared to 10 meters in the Senegal cases). Since all of the comments in the Senegal case study also apply here, nothing more need be said except to note the very high benefit-cost ratio of 4.37 and an internal rate of return of 191%.

The study by Jones et. al. (1984) is of a lift irrigation system in the Etsha area of Botswana. It is based on pumping water from a lagoon and conveying it through 1.5 km of pipe, with a lift of 1.28 meters. The soil has high infiltration rates, so a sprinkler system is used to apply the water on farmers' fields. It should be noted that there are very high net crop revenues, due to highly subsidized prices offered for new development projects in remote areas. Even so, the economic returns to this project

are barely acceptable-- the benefit-cost ratio is 1.07 and the internal rate of return is 13%. These low returns are mainly due to high friction losses through the pipe and sprinkler system.
To conclude this section, it is clear that under favorable environmental conditions, properly designed pump irrigation systems are economically sound technologies for irrigation in Africa. Biomass gasification could be an especially appropriate alternative energy technology for pump irrigation in Africa since it enables high valued use of underutilized land resources in tree plantations. Even solar energy may be feasible, with capital subsidies, especially in remote areas.

Tank Irrigation Systems

Tank irrigation systems consist of water impoundments in gullies near the base of small watersheds. Since tank systems depend on runoff for water supply, they are best suited to areas where precipitation is erratic and intense. The tanks capture the water during high runoff periods for irrigation during temporary droughts. One of the advantages of this situation is that the tank may be filled and emptied several times during the year, and thus the irrigation supply may be several times the one-time storage capacity. The tanks should be elevated above the command area for gravity irrigation, although they can be combined with pump systems. The basin must be sufficiently deep and round to provide a reasonable ratio of impounded water to dam costs, to maintain reasonable evaporation losses, and to provide dead storage for sedimentation. A crucial factor in the viability of tanks is the sediment loads from the watersheds. In India, some small tanks have been filled with sediment in only one year, while others have lasted for centuries.

The tank irrigation model to be discussed here is the "Sukhomajri" system, named after a small village in Haryana, India (Seckler, 1986). The tank has a storage capacity of about 45 acre feet of water, serving a net irrigated area of about 80 acres with supplemental irrigation. In the monsoon season from late June to October, maize, rice, and sugarcane are the major crops; in the winter season wheat is the major crop.

The tank and irrigation system was installed and operating in 1978. Although it was not monitored as well as it should have been, informal observations of the system confirm that supplemental irrigation from the tank, together with other irrigation-induced inputs, increased average yields per season 2 to 3 fold, resulting in an increased annual production of 4 to 6 fold. Indeed, one of the major problems the villagers faced during the first year was how to store and market the products, a situation they had never faced before.

One of the central problems confronting any irrigation system where water is shared is allocating the water among users. This problem is especially severe in small village

systems where water allocation can exacerbate omnipresent social tensions within the village. In an area not far from Sukhomajri, a government sponsored tank irrigation program had to be suspended because failure to solve the allocation problem resulted, literally, in murder and mayhem in the villages (Merrey, 1979). In particular, the "have and have-not" status relationships are disturbed by irrigation. The real income of landowners can double or triple, while the income of landless people remains nearly the same. The solution to this problem in Sukhomajri was to give every family in the village a right to the same quantity of water in the tank, no matter how much, if any, land they owned. Those with more land than water and those with more water than land then "truck, barter and exchange." The typical solution was that landowners would let landless people farm and irrigate part of their land on a crop-sharing basis in return for water and labor.

This institutional solution was helped, if not entirely made possible, by a technological solution to another problem. The command area is very hilly and almost impossible to irrigate by gravity conveyance systems. This problem turned out to be a blessing in disguise because it forced installation of a buried PVC pipe conveyance system, with pressure supplied from the elevation of the tank (about 40 ft above the highest point of the command area). Wherever gravity pressure is sufficient, buried PVC pipe is by far the most cost-effective irrigation distribution system. It can run up hill and down, it does not waste agricultural land for channels, and maintenance costs are virtually zero. While concrete pipes can also be used, they are a maintenance nightmare in irrigated areas where land subsidence perpetually cracks the joints.

Even more important from an institutional point of view, with pipe conveyance systems, the discharge from pipes can be measured and water usage gauged. It is easy to calculate the discharge from a pipe with knowledge of the pressure at the source and friction loss in the pipe. Thus every farmer can be assured that he receives his or her entitled quantity of water. Further, since the pipes are buried and difficult to fix if they are damaged, water stealing is virtually eliminated.

During the initial stages of development of Sukhomajri, the system was managed by an informal development organization in cooperation with a water users association elected by the villagers. The development organization was a collaborative group of the Central Soil and Water Conservation Research and Training Institute, the Haryana State Forestry Department and the Ford Foundation. The organization financed and managed construction of the irrigation facilities and assisted villagers in establishing a water users association (WUA). Water rights were established and enforced; water duties to cover O & M costs, not capital costs, were collected. After about 3 years, the WUA assumed full control of the system, and it has been working at least as well, if not even better, to the present.
Once the irrigation environment was established in Sukhomajri, other private sector activities. The villagers invested in milk buffalos to consume the extra fodder. They

found that this was such a good business that they tripled the size of the herd, and now fodder has to be imported to the village. Also, the organization provided credit and transportation assistance for small rope-making enterprises that developed from the grass produced on watersheds. It helped the village to bid for grass cutting rights on forest land that yielded a substantial profit, which was then invested in threshing machines and a school building. The Sukhomajri model is returned to later in this discussion.

While tank systems are often considered the most appropriate irrigation technology because they use local resources for construction, this judgment must be qualified. First, the design and construction of a small dam requires good engineering expertise and supervision (piping problems are endemic in small dams). Second, even small dams require a tremendous amount of earth moving that has to be accomplished in a short period of time between rainy seasons. Most villages have neither the labor nor the working skills for this highly intensive effort. Outside earth moving gangs and some machinery are usually required for earth compaction and speed. Third, the real costs of the dam per unit of water storage are necessarily higher than for larger reservoirs because of physical economies of size. Some of this cost is off-set by smaller distribution systems and better irrigation management. However, a small tank system very likely costs about the same per unit of water delivered as a well designed and constructed medium irrigation system with a command area of roughly 5,000 to 10,000 acres. This would be about twice the present value of the total costs per irrigated ha of pump systems.

Tanks also can be effectively used as "percolation tanks" to recharge aquifers for pump irrigation. In areas with pervious soils, where good aquifers exist and evaporation losses are high, conjunctive use of percolation tanks and pumps may be the best irrigation system.

Even though a small tank system costs about the same as a medium surface system, it usually provides better flexibility and control of water use. The "melons on the vine" model of China and the Mahaveli project in Sri Lanka provide excellent examples of capturing the advantage of both systems. In these systems, medium to large storage and diversion systems are used to feed water into smaller, locally controlled tanks. The physical economies of size of water storage are combined with the managerial economies of size of small, locally controlled systems.

Tanks have an advantage over pump systems in remote areas where parts and repair services are not available. In Africa, where pump equipment must be imported, tanks provide a way of decreasing the foreign exchange cost of irrigation. And, like pump systems, they do not require highly sophisticated and costly engineering expertise for design and construction.

Last, when tanks can be erected high above the command area, they can provide gravity pressure through pipes to sprinkler and drip systems. The same technique of capturing natural head through pipes can be used in high streams, simply by diverting water into the pipe. Where these opportunities exist, they provide perhaps the best of all irrigation technologies. Several such units have been installed in Guatemala with highly gratifying results (Le Baron, et. al., 1987).

Finally, while pumps and tanks should be the lead irrigation technologies in Mid-Africa, the door should not be closed on large-scale storage and diversion projects. In very arid areas that require full irrigation these systems may be the only way of generating substantial increases in food production. People who criticize these and other irrigation systems in Africa, of whom Jon Moris (1987) is one of the most thorough and articulate critics, fail to provide a rational alternative to irrigation. With the rapid growth of population, the arid areas of Africa are condemned to perpetual and increasing food dependency, rural poverty, and loss of opportunities for foreign exchange earnings through agricultural exports without irrigation systems, and in some cases large systems will be required.

References

Buringh, P., H.D.J. van Heemst, and G.J. Staring. Computation of the Absolute Maximum Food Production of the World. Agricultural University, Wageningen, The Netherlands. January 1975.

FAO, Irrigation and Water Resources Potential for Africa. Rome, 1987.

FAO, African Agriculture the Next 25 Years. Rome, 1986.

FAO, Irrigation in Africa South of the Sahara with Particular Reference to Investments for Food Production. Rome, 1987.

Foley, Gerald and Geoffrey Barnard. "Biomass Gasification in Developing Countries." World Bank, United Nations Development Program, and the Netherlands Foreign Ministry. Technical Report No. 1. January 1983.

Gittinger, J. Price. Economic Analysis of Agricultural Projects. Second Edition. The Economic Development Institute of the World Bank. Johns Hopkins University Press. 1982.

Hubbard, H.M. "Photovaltaics Today and Tomorrow," Science. April 21, 1989, pp. 297-303.

Jones, R.B., K. Rashem and David Molden. "An Assessment of Irrigation Potential in the Western Ngamiland Area From the Perspective of the Small Scale Farmer." Botswana, Ministry of Agriculture, Department of Agricultural Research. Technical Report No. 2. November 1986.

Keller, Jack. "Modern Irrigation in Developing Countries." To be published in International Commission on Irrigation and Drainage, Special Session Proceedings of the 1990 Conference. Brazil, 1989.

LeBaron, Alan D., Tom Tenney, Bryant D. Smith, Bertis L. Embry, Sandra Tenney. Experiment in Small Scale Sprinkler System Development in Guatemala: An Evaluation of Program Benefits. W.S. Project report 68. Utah State University, Logan, Utah. 1987.

Le Moigne, Guy and Shawki Barghouti. "Irrigation Development in Sub-Saharan Africa." Discussion paper, World Bank, 1989.

Malhotra, S.P. The Warabandi System and Its Infrastructure. Central Board of Irrigation and Power. New Delhi, India. 1982.

Merrey, Douglas. "Irrigation and Honor: Cultural Impediments to the Improvement of Local Level Water Management in Punjab, Pakistan." Water Management Technical Report No. 53. Consortium for International Development, Colorado State University, Fort Collins, Colorado. December 1979.

Mishan, E.J. Cost-Benefit Analysis. New and expanded edition. Praeger Publishers. 1976.

Moris, Jon. "Irrigation as a Privileged Solution in African Development." Development Policy Review. London, 1987.

Perlack, Robert P. and Carl H. Petrich. "A Comparison of Different Power Sources for Irrigation Pumping Systems in Two Agroclimatic Regions of Africa." Report to USAID, Bureau for Science and Technology. Oak Ridge Natural Laboratory, Oak Ridge, Tennessee, 1987.

Seckler, David. "Institutionalism and Agricultural Development in India." Journal of Economic Issues. Vol. 20, No. 4, December 1986.

Seckler, David. "Alternative Energy Technologies for Rural Areas in Developing Countries: A Cost-Effectiveness Analysis." 1984.

Seckler, David and John LaBore. "Agroclimatic Indices for Asia and Africa." Report to Development Studies Center, Winrock International Institute for Agricultural Development. Arkansas, 1988.

Seckler, David, R.K. Sampath, and S.K. Raheja. "An Index for Measuring the Performance of Irrigation Management Systems with an Application." Water Resources Bulletin. Vol. 24, No. 4, August 1988. pp. 855-860.

Seckler, David, Jack Keller, David Molden, David Garland, and Tom Sheng. Design and Evaluation of Alternative Lift Irrigation Systems for Developing Countries. Report to USAID Office of Energy, S & T, Water Management Synthesis Project. May 16, 1988.

World Bank, Project Performance Audit Report, Cameroon Second Semry Rice Project, 1984.

CHAPTER 6

CASE STUDY: THE SASAKAWA-GLOBAL 2000 PROJECT IN GHANA

Introduction

Although Ghana does not number among the Mid-African countries included in this study, it falls within the same agroclimatic zone and shares many of the characteristics of the region. For this reason, it is particularly instructive to examine the experience of the Sasakawa-Global 2000 project in Ghana since 1986.

The Sasakawa-Global 2000 project began as a response to the agricultural crisis in Africa during the droughts of 1983-85. The project grew out of the joint efforts of former U.S. president Jimmy Carter; Dr. Norman Borlaug, who was honored with the Nobel Peace Prize for his work on maize and wheat breeding; and Mr. Ryoichi Sasakawa, a Japanese businessman and philanthropist. Additional funding was provided by the Bank of Credit and Commerce International (BCCI).

The goal of Sasakawa-Global 2000 was to improve the availability of food and the welfare of rural people in Africa. The ultimate aim was to lay the groundwork for a "Green Revolution" in Africa that would achieve the same dramatic gains experienced previously in Asia and Latin America.

Three countries were chosen for initial pilot projects: Ghana, Zambia, and the Sudan. Two staple food crops were also targeted: maize and sorghum. The reason for the choices of country and crop were simple: these were believed to be areas "where we knew sufficient research products and information had been generated which were appropriate for small-scale producers, but which were not reaching them for various reasons."[1]

The focus of the project was thus on adaptive research and production, rather than upstream research or structural economic change. A small team was sent to Ghana in 1986 to begin identifying suitable technologies and to lay the groundwork for involving farmers and government officials. A total of 40 demonstration plots were planted in 1986; by 1988, farmer interest had swelled to the point that 18,000 farmers planted "production test plots." As many as 100,000 farmers were expected to participate in 1989.

These early results from the project have been encouraging -- indeed, remarkable. Although no sensible observer would claim that Sasakawa-Global 2000 has "solved" the problems of agriculture in its target countries, the program has clearly made a difference in the lives of thousands of people. It is worthwhile to look briefly at the project's experience in Ghana, which has been perhaps the most successful of the three countries so far.

Background

Ghana was the first African country to achieve independence in the post-World War II era. Under the leadership of Kwame Nkrumah, Ghana won its independence from Great Britain in 1957. The former Gold Coast colony was endowed with considerable natural resources, including mineral deposits and forests. Well-developed coffee and cocoa plantations dotted the countryside, and a highly educated populace appeared well-prepared for democratic rule.

Despite the promising beginning, Ghana's first three decades of independence proved challenging. In the political sphere, a series of coups and changes in government led to instability and the loss of public confidence. At the same time, the national economic situation deteriorated markedly.

From 1965 to 1980, Ghana's GDP grew at an annual rate of 1.4 percent, well behind the rate of population growth. As the trend continued through the early 1980s, the country's per capita income fell steadily. Even after several years of strong growth from 1985-87, Ghana's per capita income for the period 1965-87 showed an average annual rate of decline of 1.6 percent.[2]

Exports were stagnant, and government policies were skewed against production of commodities like cocoa and coffee, which would have provided foreign exchange earnings. At the same time, imports of consumer goods -- primarily for Ghana's urban markets -- continued at high levels. This trade imbalance placed pressure on Ghana's exchange rate, which remained fixed -- and overvalued -- despite occasional revaluations until the early 1980s.[3]

Even in agriculture, Ghana's performance turned out to be below expectations. Due in part to inappropriate government policies that discriminated heavily against the agricultural sector, agricultural production grew at a slow 1.6 percent from 1965 to 1980. This rate, too, lagged behind population growth, making for a steady decline in per capita agricultural production over the period.[4]

A World Bank study published in 1985 identified Ghana as one of the ten worst African countries in terms of "farm price discrimination." The study linked Ghana's agricultural

policies to the complete lack of sectoral growth from 1970 to 1981.[5] The bias was particularly strong against cocoa and other export crops. Ghana's volume of cocoa exports peaked in 1965; by 1984, it had fallen more than 70 percent.[6]

Ghana's low point came in the early 1980s, when the combination of severe drought and economic recession struck simultaneously. GNP fell more than 13 percent between 1980 and 1983 -- an annual decline of 4.5 percent.[7]

At the same time, per capita food production -- which had already fallen 28 percent during the 1970s -- dropped an additional 20 percent between 1980 and 1983. Declines in cereal production led the way. Ghana's cereal production fell 24 percent between 1981 and 1982; then fell an additional 47 percent from 1982 to 1983. All three of the country's major cereal crops failed in 1983. Maize production was more than 50 percent below its levels for 1979-81, and both millet and sorghum production dropped more than 60 percent.

The situation improved somewhat in 1984, as bumper crops replenished grainaries, but drought again struck northern parts of the country in 1985, reducing sorghum and millet output.[8]

The arrival of the SG2000 project in Ghana thus came at a time when national concern was focused on food and agriculture. The need for improved yields and higher productivity were well understood, and farmers were particularly open to new technologies and to change.

In the years since 1985, Ghana's political and economic situation have changed considerably. The country implemented a series of stringent economic and fiscal reforms at the encouragement of the World Bank and other donors. These are discussed in greater detail below, but they involved drastic devaluation of the cedi and liberalization of pricing and marketing policies.

The work of the SG2000 project has thus coincided with a period of economic reform and strong growth in Ghana's overall economy. GDP grew at 9.8 percent between 1985 and 1986, and growth has by all accounts remained strong since then.[9]

Maize Production

Maize stands as perhaps the most important staple food crop in Ghana. Nearly half the country's cereal area is planted in maize -- a total of about 500,000 hectares in 1988.[10] Sorghum and millet are planted on about 250,000 hectares each.

Most of Ghana's maize is produced on smallholdings, and the crop is often intercropped with cassava, cocoyam, sorghum, millet, groundnuts and cowpeas. Maize is grown throughout the country, although sorghum and millet become more popular toward the north, where rainfall is less abundant and less reliable.[11]

Dowswell notes that maize production in Ghana has increased at a rate of nearly 3 percent per year since the mid 1960s -- enough to keep per capita levels constant.[12] Most of the increase in maize production appears to have come from changes in the area under cultivation; yield levels have remained steady at about 1 t/ha, although in 1987 and 1988, the national average climbed to around 1.2 t/ha.[13]

Ghanaians eat maize in a variety of forms, including the popular dish kenkey, which is a boiled and fermented cake, usually served with soup or sauce. Average annual consumption of maize is 34 kg per person, with totals in Accra reaching 47 kg per person.[14]

About one third of Ghana's maize production is consumed by the farmers who grow it, as a subsistence crop. The remainder is sold in rural and urban communities, earning cash for the producers and providing food for the country's population.[15]

Sasakawa-Global 2000 - Project Concept

The SG2000 project began with the goal of increasing staple food production in Ghana as quickly as possible. The fundamental premise of the project was the idea that adequate agricultural technologies were currently available in Ghana for short-term gains in the production of maize, sorghum and millet -- the main cereal crops. In the words of Norman Borlaug, one of the project's originators:

> ...After consulting with research colleagues in national and international institutions, I was able to confirm that sufficient research products and information existed to greatly increase food production in most farming systems, especially those where annual moisture availability was above 700 mm. The main problem appeared to be that too few of these improved technologies were reaching farmers, especially the ubiquitous small-scale producers. Although continuing research was certainly needed to develop new and sustainable agricultural technologies for most farming systems, we had enough research products and information to begin the process of agricultural modernization.[16]

Based on this appraisal of existing technologies, the Sasakawa-Global 2000 project opted to focus on identifying suitable technological packages and making them available and practical for ordinary farmers in Ghana. Quoting Borlaug again:

> ... it became clear that there was a considerable number of improved varieties of maize and sorghum (to a lesser extent) available and considerable information concerning the improved agronomic practices (e.g., dates and rates of seeding, fertilizer requirements, moisture conservation, and weed, disease, and insect control) necessary to permit the new varieties to express their high genetic yield potential. Unfortunately the improved varieties lay largely unused on research stations and often not sufficiently tested on farmers' fields.
>
> It appeared ... that what was needed was a dynamic on-farm testing and demonstration program, along with parallel efforts in the policy arena to improve input supply systems for fertilizer, improved seed, and other inputs. While not all of the research pieces of the "production puzzle" had been developed and integrated into production packages, enough research information and products had been developed to begin the process of technological change in food production. Despite the formidable challenges in Africa, I contended that many of the elements that worked in Asia and Latin America two decades ago would also work in Africa.[17]

Technical Packages

The cornerstone of the Sasakawa-Global 2000 project is the design and multiplication of "production test plots." These are a cross between experimental plots and commercial fields, designed to convey to farmers both the technology and the benefits that accrue from it. The PTP system thus merges on-farm research with extension.

In Ghana, the PTPs are typically 0.25 - 0.40 ha, which is large enough to give a farmer a significant increase in total output. Farmers plant the PTPs themselves, on their own land. Where possible, they are encouraged to plant an adjacent plot using their traditional technology. Farmers harvest these plots, and they have the right to sell the produce -- which gives them a stake in the PTP and in using the technology properly.

The farmers receive, as part of the program, a package of the necessary inputs -- such as fertilizer or seed. In addition, the project includes a major extension component that gives farmers advice on a variety of agronomic practices. They are expected to

repay the cost of these inputs from the earnings on the PTP -- with an option of paying either in grain or in cash.[18] Generally speaking, these costs average a little more than US$ 30 per 0.25 ha PTP.

The technical package embodied in the PTPs is remarkably simple -- a reflection of the project's conviction that existing technologies are adequate for achieving much higher yields in Africa. Chemical fertilizers are the principal input. As Borlaug writes:

> At present, soil infertility is the most important factor limiting increased production in ail four countries. With little organic manure available, the projects recommend moderate use of chemical fertilizers to restore soil fertility, in conjunction with improved varieties and more optimum agronomic practices so that farmers obtain greater returns to their investments.[19]

In addition to fertilizer, the initial PTPs in Ghana called for changes in plant spacing and weeding, and for use of improved varieties. Subsequent rounds of testing, in 1987 and 1988 downplayed or abandoned the improved varieties, since farmers' local varieties "had generally shown good yield responses to improved crop management."[20]

Many of the locally grown maize varieties in Ghana contain germplasm from international research centers, and overall, "the germplasm situation in maize is excellent."[21] Improved varieties will ultimately be an important component of the overall PTP package; but for now, project leaders in Ghana believe that farmers' varieties of maize and sorghum are adequate.

Current fertilizer recommendations depend on the crop and the area of Ghana; generally speaking, however, SG2000 scientists are calling for 60-120 kg/ha of nitrogen and 40-60 kg/ha for phosphorus. In Ghana, responses to potassium do not appear to be significant. Consequently, the recommended fertilizer type has been changed from 15-15-15 to 20-20-0.[22]

Responses to fertilizer appear to be enormous. According to one project official, "grain responses of 15:1 are commonly encountered in the more impoverished soils for every kg of the appropriate fertilizer nutrients applied."[23] Another report states that applications of 40-80 kg/ha of N and 40 kg/ha of P or maize and sorghum in northern Ghana were producing yield increases of 60-100% or more.[24]

The profitability of this package has been enhanced until recently by fertilizer subsidies maintained by the government of Ghana. At the urging of donor agencies, however,

these subsidies are being removed at present. Ghana's farmgate prices for fertilizer were increased by 45 percent in 1989, and may eventually rise higher.[25]

The change in price ratios for maize and fertilizer will undoubtedly make the SG2000 technical package somewhat less profitable. But given the extremely high production responses to chemical fertilizers, there is little doubt that fertilizer use will remain an extremely cost-effective and popular technology for Ghana's farmers.

Project organizers also believe that fertilizer costs can be lowered through improved import and purchasing procedures, better distribution, and other approaches.[26] Fertilizer remains a crucial component of their strategy for increasing agricultural output in Ghana. A recent SG2000 report concluded that "the timely delivery and distribution of chemical fertilizer is the most significant constraint to increased production of maize, sorghum and other food crops in Ghana."[27]

In the longer run, project officials are aware that chemical fertilizers are not a sufficient answer to all of Ghana's agricultural problems. Other long-term issues raised by the project include soil fertility maintenance and management, credit, grain storage, varietal improvement, and seed production.

The primary conclusion of project organizers, however, is that technological packages are currently available for maize and sorghum in Ghana -- and that yield improvements can be obtained with little difficulty. As Borlaug writes:

> ...We are not waiting for the 'perfect' technology before trying to help small-scale farmers. Rather, we believe that we can help the farmer take the first step toward increased productivity and prosperity with existing research products and information.[28]

Project Accomplishments

The best measure of SG2000's success is the appeal to farmers of its PTP activities. Only 40 PTPs were planted in 1986 in Ghana; in 1987, the figure grew to 1,597; and in 1988, Ghanaian farmers grew 18,600 PTPs. Preliminary targets for 1989 were for 100,000 farmers to have participated in field testing.[29]

Table 1. Production test plots in Ghana, 1986-88.

Region	1986		1987		1988	
	Maize	Sorghum	Maize	Sorghum	Maize	Sorghum
Upper West	--	20	--	1,140	--	10,000
Upper East	--	--	--	170	--	3,000
Northern	20	--	140	--	1,500	--
Brong-Ahafo	--	--	25	--	750	--
Ashanti	--	--	35	--	750	--
Eastern	--	--	35	--	1,000	--
Volta	--	--	22	--	1,000	--
Central	--	--	22	--	500	--
Western	--	--	8	--	100	--
Total	**20**	**20**	**287**	**1,310**	**5,600**	**13,000**

Source: Chris Dowswell, "Sasakawa Africa Initiative - Global 2000 Project in Ghana: A Progress Report," prepared for Workshop 1988: Reviewing the African Agricultural Projects, Nairobi, Kenya, March 15-18, 1988; hosted by the Centre for Applied Studies in International negotiations, Geneva.)

One reason for the high rates of farmer interest is that participants have tripled their profits, according to project officials.[30] As a report for the SG2000 Southern Region office noted, "yield increase was so obvious that farmers could not doubt about the validity of the package."[31]

District-level reports for the project show that grain yields of more than 5 t/ha were recorded in some places, with widespread gains of 50 percent over traditional farmers' practices. A few sub-districts, and a number of individual farmers, recorded yields over 8 t/ha. Clearly, the SG2000 project has succeeded in identifying viable technologies for Ghana.

Another reason often cited for the success of the project and for its appeal to farmers is the participatory focus of the PTP system. Farmers themselves prepare the fields for the production test plots, and for the companion plots that they plant using their habitual practices. Often, farmers work with their neighbors in a "cluster" of farmers who follow the PTP's performance through the season.

Field days are organized to attract farmers who do not belong to particular clusters, and after harvest, interested farmers move from the production test plots to their own production plots, adopting the technology for their own farms. SG2000 itself does not purchase or manage any land, nor does it take from the farmers the crops that they grow on PTPs.

Beyond the PTPs, the most notable element of project design is probably the simple credit system that characterizes SG2000 operations. Participating farmers received fertilizer and seeds at the farmgate, with no cash advance. They are expected to repay the cost of these inputs after harvest, with an option either to pay the cost in cash or in kind, with the production from the PTP.

The option of paying in kind for the inputs, at fixed rates, essentially provides farmers with a price floor and a guaranteed market for their crops. The floor has been kept quite low in Ghana, but it nonetheless provides farmers with a potential market in the immediate post-harvest period. Farmers who were able to store their production benefited from the subsequent price rises, and paid off their loans with cash later in the year.[32]

Through 1988, over 90% of participating farmers in the SG2000 project had repaid the cost of their inputs. Partly in consequence, several Ghanaian banks have begun lending to farmers who participate in the project. About 25,000 such farmers were expected to receive commercial bank credit in 1989.[33]

In addition, a number of groups of SG2000 farmers have formed during the past several years. Several cooperatives have been developed, and these organizations show considerable promise for storing and marketing produce, and for handling input distribution and credit as SG2000 gives way to private-sector activities.[34]

Perhaps the most telling aspect of the project's success to date is the list of problems that project leaders anticipate for the future. First, because of the rapid growth of the project, input supply and distribution have become logistical problems. Second, because of the growing adaptation of the technology, production has increased -- and prices have fallen, creating marketing problems. Third, storage of produce has emerged as a real issue, and in Southern Ghana, project leaders have speculated about the possibility of selling maize to poultry producers as a way of marketing more output.[35]

Complementarities -- Research and Reform

Although the Sasakawa-Global 2000 project has clearly had a profound impact on Ghana's maize and sorghum sectors, it would be inappropriate to suggest that the

project alone has been responsible for the changes in the country's agricultural production. Two other important factors must be mentioned in discussing the success of the project. They are policy reform and agricultural research.

Ghana's policy reform efforts date from 1983, when the country implemented a stabilization and adjustment plan with the assistance of the International Monetary Fund, the World Bank and various donor agencies. The plan has featured major realignments of prices and exchange rates.

Between 1981 and 1987, Ghana's currency, the cedi, was devalued by more than 98 percent. At the same time, inflation dropped from 122 percent per annum in 1983 to 23 percent in 1986.[36] Agricultural prices were raised, and subsidies for petroleum and other commodities have been lowered or removed.

The structural adjustment program was accompanied by a major series of public investment projects, largely financed by foreign aid. These have helped to rebuild the country's infrastructure and to improve productive sectors of the economy. Among other activities, these programs have included support for road-building and other transportation improvements; rehabilitation of the ports at Tema and Takoradi; telecommunications; and mining. In addition, a major loan package aimed at improving the country's educational system and provision of essential social services.

This program of donor support for policy reform and public investment has had a major impact on Ghana's economy, and it has contributed significantly to the general success of the agricultural sector since 1985. Combined with the absence of serious drought or climatic problems, this has laid the groundwork for Ghana's economic gains.

The other major factor behind the success of the SG2000 project is the long legacy of agricultural research in the country. This has served to build up the quality of traditional varieties of maize planted in Ghana, enhancing their present-day responsiveness to fertilizer and improved management techniques.

Ghana has an old and well-established research system, which has been well staffed with trained scientists. The Crops Research Institute at Kumasi, along with the Institutes for Soils Research and Food Research, has carried out a considerably program of research on maize that dates back more than three decades.

These institutions have collaborated extensively and effectively with the international agricultural research centers, including IITA, CIMMYT, and ICRISAT. The Ghana Grains Development Project (GGDP) began in 1979, as a collaborative effort of the

Crops Research Institute and CIMMYT. Other participating institutions include Ghana's Ministry of Agriculture and the Grains and Legumes Development Board.[37]

The GGDP project has distributed a number of improved varieties of maize, and has also worked with farmers to disseminate technological packages suitable for increased yields. As for the SG2000 project, these packages focus on fertilizers, plant spacing, and other simple agronomic practices.[38] Efforts are currently underway to produce varieties resistant to maize streak virus, which has become a growing problem in Ghana.

Without the efforts of all these research activities, the SG2000 project would have entered a region with far fewer technological possibilities. The technological packages promoted by the project depend on the lengthy work that has gone on before.

Conclusion

The success of the Sasakawa Global 2000 project in Ghana is testament to a number of parallel efforts. The background of policy reform and public investment, the legacy of agricultural research, and the generally favorable climate since 1986 have created conditions conducive to the success of the project.

Nonetheless, the overwhelming popularity of the project -- illustrated in its rapid spread among farmers -- indicates that in good rainfall areas the simple technological packages promoted by SG2000 are viable and effective at the farm level.

The principle ingredient of this package is chemical fertilizer. The SG2000 project illustrates convincingly that when fertilizers are made available to farmers in a timely fashion, and in suitable forms, they can achieve remarkable results.

Although the SG2000 project is not necessarily based on a system that can be automatically reproduced in other countries of Mid-Africa, it gives hope that appropriate projects can achieve the kind of dramatic results that will be needed as Mid-Africa faces the challenges ahead.

Footnotes

1 Norman E. Borlaug, "Overview of the Global 2000 Agricultural Projects in Africa," photocopied paper, undated, p.3.

2 World Bank, World Development Report 1989 (Washington, DC: The World Bank, 1989), Table 1.

3 International Monetary Fund, International Financial Statistics, Yearbook 1988 (Washington, DC: IMF, 1988), pp. 372-75.

4 World Development Report, Table 2.

5 Kevin M. Cleaver, The Impact of Price and Exchange Rate Policies on Agriculture in Sub-Saharan Africa, World Bank Staff Working Paper Number 728 (Washington, DC: The World Bank, 1985), p. 9.

6 International Financial Statistics, pp. 374-75. See also, W. Asenson Okyere, The Effects of Domestic Policies on Exportable Primary Commodities: The Case of Ghana and Cocoa, Research Report Number 1 in the African Rural Social Science Series (Morrilton, Arkansas: Winrock International, April 1989), pp. 1-6.

7 World Bank, World Tables 1987, Fourth Edition (Washington, DC: The World Bank, 1987).

8 FAO, Production Yearbook 1985 (Rome: FAO, 1986).

9 United States Department of Agriculture, World Agricultural Trends and Indicators, 1970-88, USDA Economic Research Service, Agriculture and Trade Analysis Division, Statistical Bulletin Number 781, June 1989.

10 FAO, Production Yearbook 1988 (Rome: FAO, 1989).

11 See, for example, David H. Timothy, Paul H. Harvey, and Christopher R. Dowswell, Development and Spread of Improved Maize Varieties and Hybrids in Developing Countries (Washington, DC: U.S. Agency for International Development, Bureau for Science and Technology, 1988), p. 29.

12 Chris Dowswell, "Sasakawa Africa Initiative - Global 2000 Project in Ghana: A Progress Report," prepared for Workshop 1988: Reviewing the African Agricultural Projects, Nairobi, Kenya, March 15-18, 1988; hosted by the Centre for Applied Studies in International negotiations, Geneva, p.1.

13 FAO, Production Yearbook 1988.

14 Consultative Group on International Agricultural Research, Task Force on Sub-Saharan Africa, Strengthening Maize and Cassava Research in Eleven Countries of Coastal West and Central Africa: Request to Donors (Ibadan: Ministry of Cooperation, Government of France, 1988), p. 38.

15 N.C. Russell, Ghana's Tradition Makers: Changing Patterns in Food Crops Research, Extension, and Production, CIMMYT Today No. 19 (Mexico, D.F.: Centro Internacional de Mejoramiento de Maiz y Trigo [CIMMYT], 1989),
p. 2.

16 Borlaug, "Overview," pp. 1-2

17 Borlaug, "History of the Sasakawa-Global 2000 Initiatives for Increasing Agricultural Production in Sub-Saharan Africa," prepared for Workshop 1988: Reviewing the African Agricultural Projects, Nairobi, Kenya, March 15-18, 1988; hosted by the Centre for Applied Studies in International negotiations, Geneva, p. 3.

18 Dowswell, p.4

19 Borlaug, "Overview," p. 3.

20 Dowswell, p.5.

21 Christopher Dowswell, personal communication, August 31, 1989.

22 Dowswell, personal communication.

23 Ibid.

24 Dowswell, p.6.

25 Ibid.

26 Ibid.

27 Dowswell, p.7.

28 Borlaug, p.3.

29 Dowswell, pp 7-9.

30 Borlaug, p.5.

31 M. Galiba and E. Martinez, Sasakawa Global 2000 in Southern Ghana: Achievements and Challenges, paper presented at the SG2000 workshop, "Feeding the Future," Agricultural Technology Development Strategies for Sub-Saharan Africa, August 1-3, 1989, Accra, Ghana, p. 2.

32 Galiba and Martinez, p. 9.

33 Borlaug, "Overview," p. 5.

34 Galiba and Martinez, p. 9.

35 Galiba and Martinez, pp. 9-10.

36 International Monetary Fund, International Financial Statistics, 1988.

37 Russell, p.3.

38 CGIAR Task Force, p. 40.

Senator GORE. Our final witness is Mr. McCann. We would like you to proceed at this time. Welcome.

STATEMENT OF JAMES C. McCANN, ASSISTANT PROFESSOR OF HISTORY AND ASSISTANT DIRECTOR, AFRICAN STUDIES CENTER, BOSTON UNIVERSITY

Mr. MCCANN. Thank you, Senator Gore.

Let me say that I have had even less time to prepare my comments than my colleagues. So, let me assure you that I will be submitting for the written record a report sponsored by the American Jewish World Service on food storage and investment strategies for food storage in Ethiopia. I returned from Ethiopia a month ago.

Senator GORE. We will hold the record for inclusion of that material.

Mr. MCCANN. Let me begin by saying that as has been said here, food security is a complex issue, and for Ethiopia it certainly involves the issues of war and peace as much as it does basic farm-level production.

I think the issue here, and I am very pleased that the focus of this panel in general is on the issue of agricultural production, is that we need to know where and when to invest resources when they become available. It is very likely that we are having some significant changes taking place now and in the immediate future. So, we need to have some reasonable ideas about where effective investment can take place in agriculture.

I am by training and by practice an agricultural and ecological historian. Also, I work more as an anthropologist when I do development work for organizations like Oxfam America, Oxfam UK, the U.N. Environmental Program, and the American Jewish World Service.

I want to begin with a sense of where we have come from, what the trajectory of Ethiopian agriculture has been and then move into areas of some general recommendations that are much more specific in the documentation I will submit. First of all, there is no question that the current agricultural situation is in shambles whether you look at the macroeconomic effects or whether you spend time at the farm level as I have done in the last few years. It is a disaster in terms of productivity and certainly the war and drought have exacerbated those effects. The evidence is also very clear that this decline in productivity precedes the recent period of serious political unrest and these more intense droughts which have been more intense in the 1970's and 1980's than earlier. I can submit for the committee an article which goes into detailed evidence for this earlier decline of productivity.

The other key point is that the production crisis covers the entire region. There is a tendency to focus on the north and the northeast of Ethiopia, and I think it is important to point out that the food crisis is national. I have just spent time in southern Ethiopia and it is very important to realize that what I call coffee/maize complex which comprises the areas of the southern highlands that produce the export income for Ethiopia are on the verge of and in many cases are in direct food crisis. One of the problems of southern Ethiopia, I think, is maybe the area's "public relations," of the

image we have, and we have heard it a few times today, of rich southern Ethiopia, the place where the northern migrants have moved to and become wealthy that it is the source of all agricultural potential.

In fact, southern Ethiopia has very serious soil fertility problems. And the nature of those problems is interesting in that the soils tend to be phosphorous poor or nitrogen rich which means that they have wonderful verdant vegetative growth. The land is green, it has forests, but the lack of phosphorous in the soil means that it has very poor fruit setting capacity characteristics. So, you have wonderful looking barley and maize coming up, but the actual yield is actually quite low. This is a significant problem, and the perception about where Ethiopia's problem lies.

The last major point here before I move into looking at some specific evidence is that Ethiopian small holders on small farms produce well over 90 percent of the country's food and they are going to continue to do so for the foreseeable future. I think everyone agrees that the future of Ethiopian agriculture lies with the small holders. But we know very little about the ways in which those small holders invest their resources. How do they disinvest during times of drought? How do they invest resources they get from an NGO or how would they manage if we simply gave them cash, and how would they invest in their own enterprise? We do not have the research infrastructure in Ethiopia to give us that information and that information is essential.

A couple of examples: We have heard the figure of 40 percent forests down to 4 percent in this century. That figure was pulled out of thin air and reported about 20 years ago, and it has been quoted in the literature ever since. There is no empirical basis for it. There has been deforestation, but many of the areas where we have claimed deforestation have been part of afforestation projects, but they were not forested in the middle of the 19th century. Now, conceivably they have been at some point in the distant past, but not in recent times.

Now, other areas of southern Ethiopia have in fact naturally reforested; the forests that we are seeing now are as secondary growth. Another example, of that we don't know, is food storage. We do not know empirically what level of storage loss there is, whether it is in postharvest losses or in farmer maintained storage systems. One sees the figure 30 percent, 25 percent loss. I heard that in Ethiopia. And when you ask for the empirical basis it does not exist. And it does not exist for one important reason. Farmers know very well the storage characteristics of their crops and they will sell off or consume their crops before they are damaged by storage loss. So, again, we have to understand the system. And we need to be investing seriously in local level capacity for research and extension. Farmers know a great deal about their environment, and we have to take that information and put it together with research capacity. So, I think that must be part of any kind of investments we make.

Let me shift very quickly to the table that you have in my prepared statement, table 1, which shows the structure of cereal production from 1961 to 1984. The upshot of these figures is that we have in a period beginning before the revolution, that is, before so-

cialist agricultural policies, up to 1984 which is where the data end, but the World Bank figures confirm the trends. Here we have decline in barley, sorghum, and wheat. Significant declines. And we have a major 100 percent increase in the production of maize. This is not only true on a national basis as these figures reflect, it is also true at the local level, especially in those areas of southern Ethiopia that I mentioned. And what is remarkable about maize is that it is the most highly drought-prone crop in Ethiopia; it is significantly lower in nutrition than any of the other crops; and it is the least marketable of all of the crops. The price ratio between teff and maize is about one to six. You can get as much as six times as much in the market for teff as for maize. And maize has the worse storage characteristics. In only keeps for about 4 months before it starts spoiling.

Now, the question is, Why do Ethiopia's small farmers continue to invest in a crop which has these negative characteristics? No. 1, we need the research capacity to answer that question. If they have all of these other crops, which meet their own needs of drought resistance, productivity, adaption of local soils, why are they shifting to a crop that doesn't meet these needs?

There are a couple of short answers to that, and I won't go into much more detail. No. 1 is labor. Maize is a low-labor crop which means that if your sons are being conscripted or you are being taken to the local terracing project or they have an NGO in the neighborhood which is paying you to work on the road instead of on your crops, maize is a "terrific" crop.

Another is that maize is an annual crop. You don't have to worry if you are going to have your land taken away next year or whether your coffee trees will be given to the Government or given to someone else because maize comes in annually on a short cycle. You take it in and you put it in your store and you don't worry about it.

The other is that maize works very well with coffee. And the other figure——

Senator GORE. And chat.

Mr. MCCANN. Yes, that is another perennial crop very high income and the labor cycle works very well with maize. But those crops are declining substantially and what the farmers have left is maize with no other income.

The other, table 2, in my prepared statement, indicates another very negative trend which is the decline in total consumption across the board—that is an aggregate by administrative region, but you can see that in many key areas an absolute decline in consumption, and the consumption that is there that is very often the consumption of maize. Put together with the example that I have of a local subdistrict and coffee production in the historical important coffee growing area of Ilubabor where there has been a 70-percent reduction in the amount of coffee produced in the past decade. So, those farmers who are used to relying on coffee are in a desperate situation.

Let me just go very briefly to some implications of these figures. This again is a trajectory. No. 1, there is no change possible in this trajectory without a major reform occurring, government agriculture policies. That change is necessary but not sufficient. There

must be investments in small holder agriculture, although it is important to note that there will be no silver bullets or one new technology that solves the problem. There are already sufficient seed stocks, germ plasms to resolve these problems within Ethiopia. And they exist even in drought-prone areas. The seed stocks rebounded quicker from the drought. We must also understand farmer perceptions in the new investments. And—that is somewhat of a negative note—but the negative effect of government policy in terms of reducing service cooperatives, and to some degree peasant associations, to agents of government collection, to agents reaching into the graineries of the farmers will mean that cooperative collective investments by NGO's or by bilateral organizations are going to be resisted by farmers in the short-term future. So, I think we have to be prepared for that.

Let me conclude here, and I think maybe it is best to respond to questions at this point.

Senator GORE. Thank you very much. That is very helpful.

[The prepared statement of Mr. McCann, together with an attachment, follows:]

PREPARED STATEMENT OF JAMES C. McCANN

Food security in the Horn of Africa is a complex issue which involves questions of war and peace as much as it does the region's actual potential for producing its own food. Planning economic development for the Ethiopian region must, however, include a realistic, empirically based assessment of the region's prospects for food production in the next five to ten years. The key question is how and where should bi-lateral, multi-lateral, and NGO programs invest their resources for the maximum effect on the agricultural economy. Well over 90% of Ethiopia's domestic food supply derives from smallholder farms, yet most donors have little idea how these farms function, how their local economics have changed over the past few decades, and where current trends will take them in the next decade. To invest wisely in Ethiopia's agriculture we must know how farmers make their decisions about what to plant and how to manage their resources. In my testimony and in the full report I will place on record, I will outline what I believe is the best currently available information on key aspects of the Ethiopian region's food production and what this should mean for for future economic aid.

American Jewish World Service (AJWS), a relatively new NGO, has recognized that the mandate of most American NGOs prevents them from investing in in-depth study of local needs. The exigencies of daily operations and donor desires to see immediate, tangible results preclude comprehensive study of farming systems, food storage, and long- to medium term agricultural trends. One of AJWS's goals is to help provide such assessments to help in planning for the next decade.

I have just completed a study of local food storage systems in Ethiopia for AJWS and Norwegian Save the Children. The premise for that study was the proposition that investment in decreasing food storage losses at the farm, community, and sub-district levels might be a major factor in improving agricultural productivity in Ethiopia. The study of food storage offers useful insights into how Ethiopia's farming systems work since it necessarily involves how farmers produce, market, and consume food. My research on the potential role of investments food storage for agricultural productivity revealed some extremely important overall trends in Ethiopia's small farm agriculture relevant to the interests of this committee.

National and Regional Trends in Grain Production,

The assessment of food security in the Ethiopian region must go beyond the recent effects of drought and civil war in the north, since the historical evidence indicates that farm productivity in northern Ethiopia has been declining for most of the twentieth century. Moreover, other areas of the region not prone to drought are also on the verge of food crises. Ethiopia's medium to long-term food security requires looking at the entire region and then understanding the local effects. Table 1 indicates national trends in cereal production for the period 1961-1984. My own work at the local level with Oxfam America, Oxfam U.K. and the United Nations Environmental Program in Ethiopia confirms that these trends have continued and perhaps accelerated. Table 2 provides time series data on cereal consumption by administrative region for the period 1966-83. These data as a whole thus provide a comprehensive picture of the trajectory of food production in the Ethiopian region.

Table 1
Structure of Rural Cereal Production in Ethiopia
1961-84

Year	Percentage of Total Cereal Consumption					
	Barley	Teff	Sorghum	Maize	Wheat	Millet
1961/62	26.51	25.29	20.99	14.18	13.10	n.d
1966/67	26.55	24.02	20.62	15.65	13.17	n.d.
1970/71	26.38	23.04	22.33	15.31	12.94	n.d.
1974/75	15.33	23.38	15.59	23.71	18.43	3.56
1975/76	10.51	22.77	19.12	30.62	11.24	5.75
1976/77	19.25	24.48	16.76	22.31	10.84	4.62
1977/78	17.03	27.37	16.77	23.38	10.84	4.62
1978/79	16.62	28.34	15.65	24.15	11.20	4.04
1979/80	15.56	23.38	27.19	23.39	7.81	2.66
1980/81	19.05	25.58	26.48	15.85	9.32	2.87
1981/82	17.42	21.97	23.35	21.67	11.53	2.85
1982/83	17.06	22.01	20.89	23.75	12.40	2.99
1983/84	15.52	20.57	21.75	28.30	10.73	2.68

There are several important trends in Ethiopian agriculture evident in these data. First, there has been a major shift in farmers' choice of crops in the past twenty years. The movement has been away from crops like historical staples like barley, wheat, and sorghum. Teff, an indigenous millet-like grain, has remained the most marketable crop, especially for feeding the urban middle class. The most significant shift, however, has been the growth of maize, particularly in areas of the east and south. Since 1961 maize has increased its share of national production/consumption by 100%. In terms of food, many areas of Ethiopia have become almost crop monocultures for maize. The growth in maize production has several implications for the national food supply, most of which are worrying:

1) maize is highly drought prone (much more than sorghum and teff)

2) maize is significantly lower in nutrition than any of the crops it is replacing (sorghum, wheat, or barley)

3) of all the major cereal crops, maize is the least storable

4) maize has the lowest market price of any major cereal.

Given these characteristics, why have Ethiopia's small farmers chosen to grow more maize? The answer is not simple but several factors are clear. First, farmers prefer maize because of its relatively low labor requirements and its short growth cycle. This has made it a good complement in farms which had income from perennial crops like coffee or chat (a narcotic tree crop). Yet, as coffee and chat production in absolute and per

capita have declined in the last decade, maize has continued to increase its share. Thus as income from cash crops has declined, maize as a subsistence crop has expanded, leaving more farms vulnerable to drought, malnutrition, and storage loss. Maize's low labor requirements has also made it an attractive crop on farms whose labor supply has been sapped by government labor projects, military conscription, and food for work schemes. That maize does not store well is of little concern to farmers who consume or sell off their fall harvest by mid-March.

The problems of the trajectory of food security go beyond which crops are produced and consumed. Just as patterns of food crops have been changing, so have levels of consumption by region. Table 2 indicates that the mean annual consumption of cereals from 1966-1983 dropped from 132 kilograms per year to 94.94. Though these figures reflect crises of drought and civil war, they also include decline in regions with civil peace and steady rainfall.

Table 2

Rural Cereal Consumption 1966-83

Region	Annual Consumption per Capita (kg)			
	1966/67	1967/68	1979/80	1982/83
Arsi	180.39	203.25	130.01	190.54
Bale	125.56	n.d.	68.91	52.21
Gamo Gofa	122.64	76.54	55.10	34.24
Gojjam	190.00	90.37	173.86	134.60
Gonder	183.46	101.60	170.52	176.20
Hararge	118.99	125.06	173.56	69.32
Ilubabor	103.16	136.76	159.03	120.15
Kefa	122.81	109.26	105.69	50.70
Shewa	150.13	118.30	143.57	96.46
Sidamo	119.32	33.20	11.68	30.16
Welega	112.37	108.70	170.94	108.84
Wollo	132.38	105.79	159.20	75.83
Mean	132.38	109.89	126.84	94.94

The consistent decline of per capita cereal consumption in many areas of Ethiopia suggests fundamental problems of agricultural productivity which pre-date both recent droughts and political upheaval. This evidence indicates that relief in the form of food aid from the international community to pockets of famine will be a continuing need in the short-to medium range. The underlying issue is, of course, declining farm-level productivity and not short-term shocks like drought or even the tragic dislocations of war.

These trends have implications for many aspects of agricultural development planning. For my study of storage they suggest first that investment in improved storage for cereals moving from the farm to regional and national markets will be less critical than improving storage of emergency supplies. Second, the clear trend in cropping has been away from cereals with the best storage characteristics and toward those with the greatest storage problems. Table 1 indicates a substantial decline in barley, teff, and

wheat (the first two being resistant to storage loss), a small increase in sorghum, and a major expansion of maize. Thus on a macro level the vulnerability of national cereal stocks to storage constraints may be increasing dramatically in the past two decades. This also tells us that farmers --who are well aware of crop storability-- judge that other factors outweigh potential storage loss in their choice of what to plant.

The policy response to these factors is less clear than the trends themselves. The expansion of maize, for example, could be addressed by a major investment in improving farm and regional level storage or, alternatively, to invest resources in encouraging those crops less vulnerable to storage loss and volatile market prices. In this regard investments in storage much be viewed within a larger question of opportunity costs in agricultural resources. Arresting the general fall in farm-level productivity must be a higher priority than major investment in new storage technology.

Food Crises in Non-drought Areas

That areas of the north which have suffered from drought and warfare in the past two decades will need relief food and reconstruction of their agricultural based is obvious. Less apparent, however, are the needs of other areas of Ethiopia where food crises have been slower to develop and more subtle in how they manifest themselves. Gera sub-district forms a small part of a large agro-ecological zone in highland southwest Ethiopia characterized by a mix of annual and perennial crops, particularly coffee. The role of perennial crops in the rural economy has set the southwestern highlands apart from areas to the north and east based entirely on annual cereal crop production. As a perennial crop which provided cash income, coffee, especially in its wild state, had historically allowed food to be purchased and thus reduced dependence on annual crops. Favorable land to labor ratios allowed landlords and local government officials to invest in coffee plantations, using local corvee labor to cultivate and pick the crop.

Within the last decade, however, trends in coffee prices and government policy affecting both marketing and overall security of tenure have reversed the terms of trade between coffee and food crops, i.e. food costs more than coffee income. At the same time the rapid spread of Coffee Berry Disease (CBD) has dramatically reduced production of both wild and cultivated varieties. The result has been an increasing dependence on annual food crops, particularly maize, in historic coffee growing areas and a consequent increase in the question of storage through the hungry season.

Trends within Gera's rural economy have important implications for understanding long term trends of food production in Ethiopia as a whole. Recent data on annual crop production indicate the increasing dominance of annual crops, especially maize, over other forms of food and income. Maize's attraction within this regional farming system is based on its relative high yield and low labor requirements. Maize requires substantially less seed bed preparation time for human and oxen labor and also less time for weeding, harvest, and threshing. Maize thus has offered a useful complement to coffee whose harvest and cultivation labor demands coincide with most annual crops. Coffee's labor requirements are far less compatible with teff (which commands the highest market price of all cereals) than with maize. Thus income and labor are concentrated in the key harvest period October through December. Labor demands for village construction and peasant association coffee plantations have also contributed to the attraction of maize's low labor needs. The cumulative effect has been a concentration in a crop which stores poorly and commands the lowest market price of any major cereal. A survey indicated that by 1989 94% of all households in Gera depended on maize for their daily diet. Food consumption and production trends in Gera over the past decade are typical of a widespread phenomenon over much of the southern highlands.

Table 3

Annual Crop Production. Gera Wereda 1988/89

Crop	Hectares	Total Yield in quintals	% of total
Maize	7000	*105,000	49%
Sorghum	1003	7,021	3%
Teff	6404	44,828	22%
Wheat	2327	18,600	9%
Barley	2007	14,049	7%
Millet	49	490	.2%
H.beans	n.d.	n.d.	
F. Peas	2300	20,700	9%
Haricot	37	333	.1%

*Cumulative yield including double cropped land

A further recent shift to greater reliance on annual crops, and to maize in particular, has also been the result of the decline of coffee production. Table 4 indicates the precipitous decline in coffee production due to both Coffee Berry Disease and government marketing and land use policies.

Table 4

Gera Annual Coffee Production 1980-90

Years	Production (in tons)	% Change
1980/81	1055	
1981/82	651	-38%
1982/83	400	-38%
1983/84	775	+93%
1984/85	420	-45%
1986/87	226	-46%
1987/88	300	+32%
1988/89	350	+16%
1989/90	308	-12%

Total % change 1980-90= -70%

This trend has two direct implications for food storage: 1) the movement to maize and its poor storage characteristics means a substantial increase in vulnerability for the area's local food supply: 2) the trend in Gera confirms national-level indications that storability was not in farmer calculations nearly as important a factor in local crop choice as labor requirements, early maturity, and its mix with other crops in the system (i.e. coffee). Clearly, the threat to overall food supply from storage loss could not overcome

the stronger effects of other imperatives in the rural economy (eg. farm-level labor shortages) which favor maize and sorghum. The broader lesson of this evidence is that farm-level decisions about whether to adopt a new crop or other technology is subject to a complex set of calculations. Quick fix technologies for improving storage, raising yields, or resisting drought must be assessed in terms of how they will fit into the entire farm environment.

To summarize, there are several important trends in Ethiopia agriculture which must affect decisions about where to invest development aid:

1) overall productivity on Ethiopia's small farms has been declining for many years; drought and warfare have merely accelerated the process in some areas

2) Ethiopia's farmers have shifted cropping patterns diversified cropping toward crops like maize which have made the national food supply more vulnerable

3) overall, consumption of cereals has declined in many areas, even those unaffected by civil war and drought

4) the shift toward maize as a primary food crop in many areas represents decline in total nutritional value of food, its increased vulnerability to drought, and its vulnerability to storage damage

5) areas of traditional wealth in coffee and perennial crops (coffee and false banana) have moved toward dependency on annual crops and vulnerability to famine

6) Ethiopia's small farms have available to them crops and local knowledge to improve productivity: from the outside they will need a better policy environment and careful assessments of where development investment will have the maximum effect

7) new technologies in improved seeds, storage, and mechanization should be considered only after policy reform and careful assessment of farm-level needs.

8) the international community must help rebuild the agricultural research infrastructure in the region rather than relying on imported technological quick fixes.

The Ethiopian region in whatever political configuration it takes in the near future will require substantial amounts of international relief and development aid. The decline in its agriculture, however, is rooted deeper than the effects of civil war and drought. Potential donors, including USAID, NGOs, and relevant local actors in the Ethiopian region must be prepared for major, long-term reinvestment in its rural economy.

Journal of Interdisciplinary History, XX:3 (Winter 1990), 389–416.

James C. McCann

A Great Agrarian Cycle? Productivity in Highland Ethiopia, 1900 to 1987

Stagnant rural per capita production and the loss of entitlements to food through markets and political networks have resulted in crises of subsistence for many agrarian societies in the developing world. Contemporary observers of these crises have blamed climate, regional conflict, international economics, and government policies for the consequent famines and episodic food shortages. Yet, crises such as the famines of the 1970s and 1980s in northern Ethiopia did not emerge full blown, but evolved as much from the internal dynamics and limitations of small-scale peasant agriculture as from the workings of the international economy. For many, the famines in northern Ethiopia have provided sufficient evidence of the negative consequences of drought and bad policy, and the effects of internecine conflict. This article shows that the poor performance of Ethiopia's agricultural economy—especially in the famine-prone north—did not begin in the 1970s with drought and the declaration of socialism, but was evident well before the 1950s.[1] It also pushes the time scale back even further, and examines the historical evidence for the decline of highland Ethiopia's agrarian economy in the twentieth century.

The agricultural circumstances of highland Ethiopia are not unique in the contemporary world or in history. Its rural sector over the course of the twentieth century has resembled a "prein-

James C. McCann is Assistant Professor of History and Assistant Director of the African Studies Center, Boston University. He is the author of *From Poverty to Famine in Northeast Ethiopia* (Philadelphia, 1987).

The author is grateful to Dessalegn Rahmato, Allan Hoben, Tekalign Wolde Mariam, Michael Glantz, and participants in the workshop "Agrarian Transformation in Northeast Africa" at Boston University for comments on an earlier draft of this article.

1 For arguments and data on the decline of agricultural productivity in the 1950s, see Warren Robinson and Famika Yamazaki, "Agriculture, Population, and Economic Planning," *Journal of Developing Areas*, XX (1986), 385. For the 1960s, see Dessalegn Rahmato, "The Peasants and the Comrades: Problems and Prospects of Socialist transition in Rural Ethiopia," paper presented to the African Studies Association (Denver, 1987).

dustrial society characterized by slow technical change where processes of growth are still dominated by the play between demographic expansion and limited resources," a description as applicable to highland Ethiopia in the 1920s or 1970s as to sixteenth-century southern France. Although a modern political economy has emerged at Ethiopia's center since the 1920s, the traditional peasant economy of the northern and central highlands has not significantly altered the fundamental limits on its productive capacity. On the contrary, key factors governing the productivity of both land and labor have declined. At the same time, peasant entitlements to the benefits of economic growth elsewhere in the Ethiopian economy—most notably in the cities and in the south and west—have failed to materialize for small farms in the northern and central parts of the country where famine is endemic.[2]

The twentieth-century conditions of rural production in northern highland Ethiopia reflect a historical conjuncture between the mature stage of an agrarian economic cycle and the growth of a modern political economy and state. This article outlines the evidence for a decline in productivity and, more broadly, for the progression of a population-driven agrarian cycle which had reached a point of crisis in the previous two to three generations. The agrarian cycle for early to mid-twentieth-century Ethiopia has resembled what Le Roy Ladurie has called the "Malthusian scissors," which opened as population expanded into relatively abundant resources of land and capital, but closed rapidly in many regions as per capita productivity stagnated. Both phases of this cycle are visible in Ethiopia's twentieth-century records; in the past two decades, however, the latter stages have been dominant. Drought and political change have merely set these fundamental processes in stark relief.

The maturation of the agrarian cycle over the last few generations has not been a uniform process, nor one easily docu-

2 Emmanuel Le Roy Ladurie, *The Peasants of Languedoc* (Urbana, 1976), 296. Sen argues that the concept of entitlements accounts for the uneven distribution of famine within a regional and national economy. See Amartya K. Sen, *Poverty and Famine: An Essay in Entitlements and Deprivation* (Oxford, 1981). My analysis is restricted largely to the areas of highland cereal production, which were hardest hit by famine. My field experience and research include Wallo, Gondar, Gojjam, northeastern Shawa, and the Wubera and Babile regions of Hararge.

mented. This article traces over time particular features of the agrarian economy which illustrate the overall decline in productivity, including the evidence of demography, climate, technology, social and property relations, cropping systems, nonagricultural land use, and the effects of politics. It is based on archival records, field observations of contemporary trends, oral testimony, and technical data on farming systems. As often is the case, it has been necessary to extrapolate the historical trajectory from contemporary field observations and to infer regional trends from local data. Nonetheless, a persuasive portrait emerges from these sources of a rural economy which has failed to transform its fundamental productive capacity in the face of the closing Malthusian scissors and the increasing demands of a modern state.

DEMOGRAPHY: NEW EQUATIONS OF PEOPLE AND LAND Demographic expansion is the primary variable driving the cycle of agrarian productivity and accounts to a large degree for regional, local, and temporal variations in forms of agriculture, uses of labor, and land-tenure arrangements. In some locales, a relatively low ratio of population to land and capital resources has allowed economic expansion, whereas in other areas population pressure has suppressed both gross product and per capita production.

The historical evidence for demographic variations throughout the highlands and across time is primarily qualitative. Since we do not have a comprehensive data set or historical studies for all of the regions, we must rely on indicators of demographic change such as correlations between population density and forms of agricultural activity. These include forms of labor, methods of land distribution, and estimates of household landholding. Such features reveal themselves in oral evidence, in regional survey statistics, and in field observations by travelers and officials. This evidence indicates that, although the population has not been distributed evenly, there has been a fundamental logarithmic progression of population growth throughout the present century in Ethiopia's northern and central highlands.

At the opening of the twentieth century, the population of many regions of the northern highlands had begun a period of recovery after depopulation which was the result of the major famine and epidemic of 1889–1892 and Mahdist invasions along the western marches with Sudan. The recovery proceeded slowly,

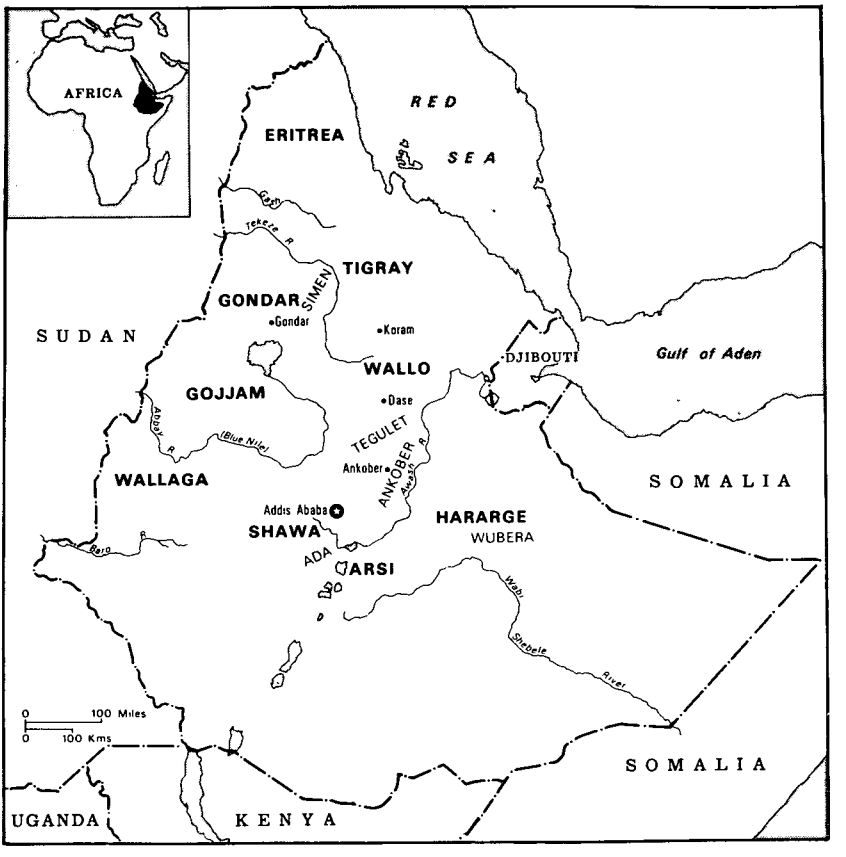
stumbling during regional droughts or epidemics, and certainly halting during the 1917–1919 influenza pandemic. Italian censuses from Eritrea—one of the few statistical sources—indicate that the highland populations continued to grow even though aggregate food production faltered. The average annual rate of growth for Eritrea was therefore 2.9 percent, remarkably close to the natural rate for all of Ethiopia in the 1980s.[3]

A pattern of general population growth across the highlands throughout the 1920s and into the postwar years emerges from a mix of sources. The best hard evidence of the interaction of population growth, migration, and declining productivity is comparative aerial photographic data for the period 1955–1975 from the Simen region. They closely resemble Italian estimates for Eritrea in the prewar period. In Simen, the highland population rose by an annual rate of 2.4 percent in the most populous and productive elevations (barely below the natural 2.5 percent increase), but rose 3.58 percent in the lower elevations—strong evidence of local migration. Since 1964, the upper limit of cultivation in the Simen region has risen 100 meters, to just below the frost line, marking the end of a long-standing trend of localized movement. Evidence from this region, which historically and ecologically resembles the western areas of Tigray and Wallo, and parts of Gojjam, suggests that localized migration and the expansion of cultivation are products of population growth. This pattern illustrates statistically the much wider trend of immigration to less productive and higher risk cultivation in the lowlands evident earlier along the eastern escarpment below the road to the north. Lowland zones, which had been used primarily for pastoral wet-season grazing, have been cultivated in the past one or two generations by migrant highlanders. The patterns are similar to those followed from 1900 to 1920 in the northwest Gondar region along the Sudan border.[4]

3 Istituto Agricolo Coloniale, *L'Economia Eritrea*, 43–44, cited in Tekeste Negash, *Italian Colonialism in Eritrea* (Uppsala, 1987), 149. For the decline of food production from 1921 through 1931, see F. Santagata, *La colonia Eritrea nel Mar Rosso davanti al'Abissinia* (Naples, 1935), cited in Irma Taddia, *Eritrea-Colonia, 1890–1952* (Milan, 1986), 276. On the relative gain of highland population versus pastoralists, see Tekeste, *Italian Colonialism*, 150. The 2.9% growth rate is my calculation based on the Italian censuses cited by Tekeste. The 2.5% rate is cited from Ethiopia's Central Statistical Office, Addis Ababa.

4 B. Messerli and K. Aerni (eds.), *Simen Mountains, Ethiopia: Cartography and its Application for Geographical and Ecological Problems* (Bern, 1978), 34. In the Debre Berhan area,

Fig. 1 Ethiopia's Northern Highlands



Map prepared by Eliza McClennan, Department of Geography, Boston University.

The story of the lowland regions east of the old Shawan capital of Ankober reveals the generalized pattern of regional population dynamics which has emerged in the twentieth-century agrarian cycle. The lowland districts of the Ankober region lie between 1500 and 1200 meters altitude and are inhabited by a

where frost and waterlogging are the primary constraints on cultivation rather than drought, movement to higher elevations is clear. Guido Gryseels and Frank Anderson, *Research on Farm and Livestock Productivity in the Ethiopian Highlands: Initial Results, 1977–80* (Addis Ababa, 1983), 9.

mixed Amhara Christian and Muslim Argobba population, although the region as a whole has received a steady influx of highland Amhara settlers since the mid-nineteenth century. Life histories of the present inhabitants reveal a consistent movement into these lowland areas by highland Christian farmers who were the younger, dispossessed children of households located in the highlands to the west. Prior to land reform in 1974, elder siblings were able to "buy off" the claims of younger family members, thereby retaining viable holdings. The new migrants arrived first as tenants using *magazo* (sharecropping) agreements with local Muslim landholders and have continued to arrive since the land reforms of 1975 to claim the diminishing stock of open land. Then, as now, migrants have been attracted by average landholdings in these lowland areas of 2 to 2.5 hectares, substantially above the current average of 1 to 1.5 hectares for the adjacent highland area.[5]

The Ankober experience has wider applications since the district resembles the extensive ecological belt below the eastern escarpment—an area with low agricultural potential. The limits on agricultural productivity in this lowland zone are due less to land shortages and soil infertility than to the problems of climate variability inherent in lowland zones where drought, particularly affecting the important spring rains, plays a critical role for marginal farms. Beyond the loss of crops, the greatest effect of erratic rains has been to deplete the supply of oxen, which have died more from the lack of dry season forage than the lack of water. Overall, the increase of population in such areas through inmigration and natural population growth has not so much depleted agricultural resources as it has substantially increased the proportion of the population susceptible to climate variation.

The highland Tegulet district, 100 kilometers northwest of Ankober, provides a complementary model, closely resembling the demographic growth trend evident in the Simen region. In Tegulet, one of the highland areas which has been settled longest, population pressure grew steadily until after World War II, when

5 Landholding data are based on my work in the two regions. For the historical context, see Svein Ege, "Chiefs and Peasants: The Socio-Political Structure of the Kingdom of Shawa about 1840," unpub. M.A. thesis (Univ. of Bergen, 1978), 60–63.

there was an apparent acceleration. Pressure from new households to expand cultivated areas has virtually eliminated pasture, and landholdings have dwindled in the postwar period to less than 2 hectares. In the past two generations, even the river flood plains 1,000 meters below the plateau have been cultivated. The overall effects of such pressure on per capita productivity are evident: farmers plow with cows because of the shortage of livestock and pasture; until the reforms of 1975 landlords hoarded small hay-producing plots as a source of income and leverage over their fodder-poor tenants; and the age of first marriage has increased dramatically since there is no land to allocate to new households. Similar conditions exist in long-settled highland areas from northern Shawa through to Eritrea.[6]

The population crisis building over the course of this century is not restricted to the northern highlands. In the Wubera region of Hararge, household landholdings average less than .5 hectare, and pasturage has all but disappeared. The Wubera rural economy depends on the sale of *chat*, the narcotic leaves of a perennial bush, to offset the subsistence food deficit, since the average household can produce only about 600 kg. of grain in the best years, a nine- to ten-month supply. This capacity has declined in the last two generations in direct proportion to population growth and a reduction in the amount of land per household that is used to produce annual crops, especially maize. Yet, per capita chat income has also declined dramatically as existing chat bushes have been divided as property among male descendants. Other signs of population pressure are clearly marked. The oldest inhabitants can still recall when the region was heavily forested and there was substantial pasture which supported an agro-pastoral economy based on subsistence crops—maize and sorghum—and a diet of milk and *gunfo* (a cereal/milk paste). Cash income from chat (and coffee in other areas of Hararge) and the consequent relatively heavy involvement in a regional cash market economy has buffered the effects of the demographic explosion, although the basic

6 International Livestock Centre for Africa (ILCA) baseline surveys of the Ada and Debre Berhan areas report the trend toward reduction of fallow and pasturage. For a discussion of the needs for intensification, see McCann, unpub. report to Oxfam U.K. on Evaluation of Hararge Projects (Oxford, 1987); *idem*, unpub. report to Oxfam America on Evaluation of Ox/Seed Project (Boston, 1986).

constriction of resources available to household production units in traction, forage, and productive land has created a dependence on international food donations during the 1980s.

Population growth in and of itself would not necessarily have had a negative effect on rural productivity, except that the prevailing relations of property, technology, and inheritance have led historically to migration and expansion into new land rather than a general intensification of labor with the application of new technology and cropping systems. The presence of northerners as part of the conquest and occupation of the south reflects not only the pull of Ethiopia's modern political economy but also the steep decline of the northern rural economy. Thus the farming population from some of the more densely settled portions of the highlands had already begun a migration away from their agricultural bases and incorporated trade as a primary economic strategy.[7]

The historical relationship between population growth, migration, and economic decline appears most graphically in the gradual movement of Tigray's rural population north to south and out of agriculture as early as the middle of the nineteenth century. Drought and political instability accelerated this process, although it was fundamentally based in the limits of ecology and small-farm economics. Indeed, the political unrest which has characterized Tigray and the other northern regions since the late nineteenth century has been the result—not the cause—of declining agricultural resources. By the early 1880s, Tigrinya-speaking migrants from Eritrea had already arrived in the Wag region of Wallo and settled there as farmers. From at least that period, Tigrinya speakers had penetrated into northern Wallo as farmers, and even more importantly as part of a mercantile migration which penetrated south along the caravan route to Shawa. As small market towns emerged along the road to Addis Ababa to manage the regional trade in hides, salt, and grain, Tigrinya-speaking small merchants and entrepreneurs played a prominent part. Many of them shifted to full-time commerce after a beginning in petty agricultural trade. The income from local-level

7 See Sven Rubenson, *The Survival of Ethiopian Independence* (London, 1976), 378; McCann, *From Poverty to Famine in Northeast Ethiopia: A Rural History, 1900–35* (Philadelphia, 1987), 187. For greater detail on push factors, see *idem*, "Households, Peasants, and the Push Factor in Northern Ethiopian History," *Review*, IX (1986), 369–411.

30-597 - 0 - 90 - 14

trade, especially in the eastern regions of Tigray and Eritrea, sustained those economies past the viability of agriculture. By the late 1960s, Bauer found that petty trade was entrenched as a strategy for supplementing income in eastern Tigray.[8]

It is far more difficult to find data to determine the precise origins of agricultural stagnation or to discern periods of recovery amid general decline than to identify the overall phenomenon. Nevertheless, by 1926, Talamonti, the Italian agent in Tigray, argued to his superiors in Italian Eritrea that Tigray and the north were in a "virtual famine condition," despite the lack of major ecological catastrophes in that period. Such evidence as exists suggests strongly that the decline of the agricultural economy progressed in a north-south direction, affecting the east more fully than the west. Eritrea and Tigray experienced the crisis earlier than Wallo, and Gojjam has yet to feel the full effects. Eritrea's consistent demand for grain from Sudan and the northwest Gondar region and its fall in food production through the 1920s are further indicators of the loss of northern Ethiopia's agricultural base.[9]

CLIMATE: THE RHYTHM OF THE SEASONS The agricultural cycle of labor, social reproduction, and resource allocation in the northern highlands reflects primarily the patterns of rainfall. The historical role of Ethiopia's climate has been an enigma, largely because of the lack of complete rainfall data, confusion between drought and famine, and failure fully to understand the relation-

8 This characterization was made in both historical and contemporary terms in interviews of residents of northern Wallo. See McCann, *From Poverty to Famine*, 188. For Tigrayan evidence, see Dan F. Bauer, "Land, Leadership, and Legitimacy among the Inderta Tigre of Ethiopia," unpub. Ph.D. diss. (Univ. of Rochester, 1972), 15. Bauer's evidence argues that the shift to petty trade was based on the weakness of the agricultural economy rather than an open choice to diversify household income.

9 Talamonti to minister, Addis Ababa, Archivo Storico delle Ministero Africana Italiana (Rome), 37/6, 54/36, 8 Aug. 1926. The annual dura trade statistics appear in annual reports from the Central Economics Board (Khartoum). For Eritrean food production figures, see note 4. The precipitous decline in Eritrea's production was accelerated by Italian labor policies, especially military conscription. See Tekeste, *Italian Colonialism*, 48–50. From the work of Stitz, a geographer, it is clear that there is a strong correlation—at least in traditional Christian areas—between length of settlement, church foundation dates, and population densities. Areas of highest density are in Tigray, norhern Shawa, and northern Wallo. Gojjam was settled by Christian highlanders only in the sixteenth century. Volker Stitz, "Distribution and Foundation of Churches in Ethiopia," *Journal of Ethiopian Studies*, XIII (1975), 1, 17, for the distribution of foundation dates.

ship between climate and human action. Most of the historical studies of climate in Ethiopia have therefore focused on records of famine and/or drought as reported in royal chronicles, church documents, and the accounts of foreign travelers. Such records are spotty and impressionistic, and tend to feed the myth of a famine cycle in Ethiopia.[10]

Climate as a feature of ecology is, as Cronon has noted, not a constant but historical and dialectic. The interaction of climate with human activity is the key issue, not climate in isolation. Although meteorological droughts have been a fact of climate history across Ethiopia in the twentieth century, far more critical have been the interannual variations at the beginning and end of the seasons—uncertainties to which farmers have had to adapt. Moreover, the variations of climate from month to month and year to year have a far more serious impact on farm decisions when per capita resources such as land and livestock have declined relative to population. Thus climate affects human activity within a single year's seasonal cycle as well as in year-to-year climatic variation, not merely as a static independent variable.[11]

The rainfall calendar for the northern highlands follows a seasonal pattern, within which variation is a significant feature. The dates of seasonal transition—that is, the onset and end of the two rainy seasons—constitute the most significant variable for

10 Workineh Degefu, "Some Aspects of Meteorological Drought in Ethiopia," in Michael Glantz (ed.), *Drought and Hunger in Africa: Denying Famine a Future* (Cambridge, 1987), 27, indicates that for highland agriculture rainfall and moisture availability are the key "limiting factor[s]." For treatments of history and drought, see Bahru Zewde, "A Historical Outline of Famine in Ethiopia," in Abdul Mejid Hussein (ed.), *Rehab: Drought and Famine in Ethiopia* (London, 1976); Richard Pankhurst, "The Great Ethiopian Famine of 1888–92: A New Assessment," *Journal of the History of Medicine and Allied Sciences*, XXI (1966), 95–124, 271–294; Degefu, "Some Aspects," 29–31.

11 William Cronon, *Changes in the Land: Indians, Colonists, and the Ecology of New England* (New York, 1983), 13–14. Glantz makes an important distinction between agricultural drought and meteorological drought. See Glantz, "Drought and Economic Development in Africa," in *idem* (ed.), *Drought and Hunger*, 47–48. Rainfall variability is highest in lowland areas, that is, those most recently occupied by agriculturalists in the past half-century. Given those settlement patterns, the incidence of agricultural drought has increased in the past two generations. The climatic phenomenon of the coincidence of high variability and low rainfall levels is also mentioned by R. P. D. Walsh, "The Nature of Climatic Seasonality," in Robert Chambers, Richard Longhurst, and Arnold Pacey (eds.), *Seasonal Dimensions to Rural Poverty* (London, 1981), 16, 21. Walsh notes that patterns of seasonality change over time have generally meant greater variation in the dates for the beginning and end of the rainy seasons.

agriculture. In most northern highland areas, rainfall is bimodally distributed, creating three seasons: *keremt* (a summer rainy season from late June to September), *beig* (light spring rains from March to early May), and *bega* (the dry harvest season from October through February). Except in areas above 2,800 meters, where summer frosts are a problem, the main growing season is in the summer, with a crop planted in late June or July and harvested in December and January. Spring rains allow a smaller, but often significant crop which is harvested just prior to summer planting. In January and February, the major harvest months, rainfall is minimal; the sun-baked, heavy soil and limited forage for oxen in these dry months prevent postharvest plowing. In March and April, the mean level of rainfall increases, but there is a significant degree of year-to-year variation in the total amount over these two months. In May and June, the amount continues to increase with great variations in reliability by region. By late June and early July, the main rains begin, and they continue through September. Variability steadily decreases into July and August.[12]

The effects of seasonality and interannual variation on agricultural change in the highlands can be seen in the impact of the spring rains, which play a critical role in the rural economy of the northern and central highlands. Although they account, on average, for only 5 to 15 percent of the total annual crop, resource-poor farms, which lack both capital and credit, depend upon the spring rains to provide a critical margin of productivity. In addition to supplementing food supplies, spring rains allow for more effective and timely seedbed preparation, and regeneration of livestock resources by improving pasture. As overall resources of land and capital have declined with population growth, the lack of reliable spring rains has had an increasing impact on agricultural production, helping to produce a new class of poor, indebted farmers.[13]

Climate statistics show clearly that spring rains fail more often than the main rains in all highland zones. When spring rains

12 Ethiopian Delegation, "Climatic and Drought Conditions in Ethiopia," paper prepared for the Scientific Roundtable on the Climatic Situation in Africa (Addis Ababa, 1984), 4.

13 Dessalegn has reported that some farmers in Wallo have begun to avoid spring planting in favor of supporting their livestock (personal communication, 1988). For most others, in my experience, spring crops were far more critical to food and seed supplies.

fail, poor farmers have had to borrow new seed, obtain food, and pay higher costs for obtaining oxen in preparation for the main rains. During spring droughts, poor farmers have faced a classic dilemma of whether to plant spring crops or to allow their fields to regenerate as pasture to sustain livestock into the main plowing season. In the Debre Berhan area of northern Shawa, for example, the problem is particularly acute, for there is sufficient rainfall for a spring crop only once every three years, yet declining supplies of land have forced cultivation in frost-prone areas where only spring crops are possible. In many highland areas, increasing reliance on spring rains for food and capital is a distinctive feature of the twentieth century or, more fundamentally, the mature stage of an agrarian cycle.[14]

Dependence on spring rains is not the product of drought per se but of the interaction of climate with social and economic change on the agrarian scene. In fact, effects of climate vary depending on the maturity of the agrarian cycle itself—that is, the density of settlement, use of marginal lands, and distribution of capital resources. (For example, a given amount of rainfall on the Ankober lowlands in 1910 would have an entirely different human effect than the same amount in 1985.) Agricultural droughts are not necessarily the cause of economic decline, but they exacerbate the weakness of resource-poor farms. Recent work on famine victims suggests that capital-poor farmers lacking stored food, credit, and key productive resources have been hardest hit by droughts when they have occurred.[15]

TECHNOLOGY: THE TOOLS AND TECHNIQUES OF PRODUCTION

Highland agricultural technology is based on the equipment, cultigens, and agronomic techniques of its distinctive dryland farming system. The single-tine scratch plow, a pair of oxen, an array of leather, wooden, and iron processing tools, and an iron plow tip have long served as the capital equipment of the rural farming households. The work of Michels and Simoons suggests strongly that the plow and dryland agriculture have been part of the north-

14 Gryseels and Anderson, *Research*, 9–10.

15 This evidence derives from over 100 interviews conducted in 1985 and 1986 in northern Shawa. See McCann, "The Social Impact of Drought in Ethiopia: Some Implications for Rehabilitation," in Glantz (ed.), *Drought and Hunger*, 256–259; *idem*, unpub. report to Oxfam (1986).

ern highland farming system since the first millennium. The plow came later to areas in the south and west which were incorporated under the aegis of Menilek's late-ninteenth-century state, yet its adoption had less to do with Amhara stewardship of the rural economy than it did the economic advantages of the system and longer-term spontaneous agricultural settlement of Cushitic pastoralists.[16]

Remarkably, since then there has been very little innovation in the design, materials, or uses of this farm equipment; and more advanced technologies (for example, irrigation, mechanization, and incorporation of new forms such as viticulture) have rarely been introduced. Imported steel plowshares replaced local wooden or iron tips in the early twentieth century, but this departure was more a change in durability than in concept. Surprisingly, the shift to moldboard steel plows, harrows, and seeding equipment which led to increased productivity in Europe has not yet occurred in Ethiopia. Even where agronomic techniques have been adapted to local conditions, such as the use of broadbeds to avoid waterlogging or terracing to increase the amount of usable land, farmers have not adopted new tools for the task. Despite the occasional use of horses, donkeys, camels, and cows, oxen have remained entrenched as the traction animal of choice. Indeed, the economics of smallholder farms and risk-aversion strategies have produced resistance to such change and even the abandonment of such techniques as terracing and irrigation, which had been employed in the past or in other locations.[17]

The mechanization of smallholder agriculture, even in the most developed agricultural zones of highland Ethiopia, has been marginal. The reasons for this lack of capital intensification are

16 Joseph Michels, "The Axumite Kingdom: A Settlement Archaeology Perspective," paper presented to the Ninth International Conference on Ethiopian Studies (Moscow, 1986); Frederick Simoons, "Some Questions on the Economic Prehistory of Ethiopia," in John D. Fage and Roland Oliver (eds.), *Papers in African Prehistory* (Cambridge, 1970), 124–29. Non-Amhara information derives from interviews held on 4 July 1987 with Baker Daud (age c. 100) and Yusef Chela (age 75) at Lelissa Peasant Association, Wubera, Hararge. Hassan argues that agriculture in the Wubera region diffused from the vicinity of Harar Town. See Muhammad Hassan, "The Relationship between Harar and its Surrounding Oromo between 1800–1887," unpub. B.A. thesis (Haile Sellassie I Univ., 1973).

17 Recent ILCA adaptations of the ox-plow technology, such as seeding attachments, single-ox plows, or broadbed makers, have shown promise but not much spontaneous adoption. See Gryseels and Samuel Jutzi, *Regenerating Farming Systems after Drought: ILCA's Ox/Seed Project, 1985 Results* (Addis Ababa, 1986).

twofold: First, because the highland rural economy is characterized by a surplus of labor, the opportunity cost of labor during key periods when farm operations need mechanization (during spring plowing, harvesting, and threshing) is close to zero. Oxen are indeed a scarce resource, but those farmers without animal traction are also those least able to employ mechanization. Second, credit within the traditional rural economy is scarce and prohibitively expensive for the vast majority of farmers, even for small-scale additions of equipment. The usurious annual rate of 120 percent has been traditional across the highlands throughout most of this century. Although some wealthy members of the elite may have been able to afford investing in new forms of technology, the historical dominance of tenancy rather than the development of plantations or other forms of direct elite involvement in agriculture has discouraged innovation on the part of both farmers and the elite. Only in areas of severe labor shortage and large private landholdings, such as in the Setit-Humera region on the Sudan border or the Awash valley, has mechanization taken hold.[18]

The reasons for such technological conservatism in highland agriculture are open to debate. Merid Wolde Aregay has placed the burden of technological stagnation firmly on the social system inherent in peasant land tenure and the insecurity of the income rights of the elite in the agrarian political economy. Merid argues strongly that the system of land tenure and partible property rights (*rist*) and the elite-control of income rights (*gult*) from agriculture have stultified technological initiative.

18 There is often a demand for labor at harvest. See Gene Ellis, "Man or Machine, Beast or Burden: A Case Study of the Economics of Agricultural Mechanization in Ada District, Ethiopia," unpub. Ph.D. diss. (Univ. of Tennessee, 1972), 41. For rural interest rates, see Vinigi Grottanelli, *Richerche geografiche ed economiche sulle populazione: Missioine de Studio al Lago Tana* (Rome, 1939), 147–48. See also McCann, "Households, Peasants, and Rural History in Lasa, Northern Ethiopia 1900–35," unpub. Ph.D. diss. (Michigan State Univ., 1984), 93, n. 55; Bauer, "Land, Leadership, and Legitimacy," 131. Ellis' work on Ada (40 kilometers south of Addis Ababa) in the early 1970s has pointed out the uneconomic nature of mechanized agriculture even in the most developed, market-oriented highland farming systems. Land fragmentation, the low opportunity cost of labor, and problems of maintenance rendered tractors highly uneconomic. More important, the yields from mechanized plots were not significantly higher than those using ox-plow methods. See Ellis, "Man or Machine," 26–32. For a dissenting view on mechanization and a description of Setit-Humera, see Dessalegn, "Moral Crusaders and Incipient Capitalism," *Proceedings of the Third Annual Seminar of the Department of History* (Addis Ababa, 1986), 71–72.

> He [the peasant] knew the quality of his soil and what soils were more receptive to what grains. He understood at which levels of the highland each type and strain of his grains thrived best. Travellers, from F. Alvarez down to H. Salt, saw how carefully he could irrigate his lands as well as tend and grow fruit trees of all kinds. . . . The low level of life of the Ethiopian peasantry and of the ruling classes cannot, therefore, be attributed to primitive technology. The *rist* form of tenure and the endless segmentation of farms that it entailed deprived the peasant of the will to work and to seek improvement. It made him quarrelsome while at the same time shutting and fixing him within the confines of his ancestral village. . . .[19]

This perspective highlights the relationship between technological innovation and social processes, but also risks idealizing peasant knowledge as a phenomenon outside of the dyadic relations between farmers and overlords. As Merid suggests, examples of new forms of technology abound, but systematic application has been extremely limited. Indeed, the fragmentation of political authority which characterizes highland political culture has inhibited the cooperation necessary to sustain irrigation, especially in the face of demands on upstream resources resulting from population growth. In fact, some of the most visible forms of innovation have resulted from the adaptation of labor and the distribution of land in areas of low population density rather than technological change under population pressure, the opposite of most experiences of agricultural intensification. Crises in climate and food resources, far from stimulating innovation, have driven smallholders further into conservative risk-aversion strategies.[20]

The impasse of technology amid crises of diminished resources in land and capital has placed a severe limit on the agricultural economy's ability to raise productivity. The traditional demographic equations of land and labor have depended on specific technological boundaries. The failure to alter those con-

19 See Merid Wolde Aregay, "Land Tenure and Agricultural Productivity, 1500–1850," in *ibid.*, 115–130. *Rist* is the distinctive land tenure system of the Ethiopian highlands, based on ambilineal descent. *Gult*, often glossed as "feud," denotes the "bundle" of income rights over land held by local and regional elite.

20 I have observed this phenomenon in the Ankober lowlands, where locally innovated irrigation has virtually ceased because of new upstream water demands. I am grateful to Dessalegn for pointing this general effect out from his own work in Wallo.

straints over time has subjected productivity to the limitations of local and regional agrarian cycles of population growth and decline.

SOCIAL AND PROPERTY RELATIONS The relationship between population, agricultural productivity, and the adaptation of social institutions has been a major source of consistency within the twentieth century. Among the most salient historical evidence on social adaptation of the farming/social system of the highlands is the expansion of that system's package of crops and technology to new regions. The cultivation of cereals using the highland plow has been expanding from its northern core for several centuries. With the farming system has traveled a distinctive set of property rights, including ambilineal descent and partible property, and an expansionist political culture. The military ability of the imperial state and its local equivalents to expand their own tributary hegemony underwrote the natural flow of population to the frontiers of culture and cultivation.

The expansion of the plow-based dry-land farming system to new locales was a prerequisite for establishing imperial control. The first expansions occurred in areas of ideal climate and elevation on the southern perimeter of Amhara/Tigrayan settlement, a frontier which has advanced considerably to the south and west since Axum. The steady southern movement of imperial capitals since Axumite times was at least partially an indication of a series of progressive shifts to areas of less intensive cultivation and higher productivity.[21]

The imperative to expand is explained as much by the needs of the farming system as it is by the military tradition of northern Ethiopia. The historical ability to incorporate new zones has obviated the need to intensify labor or adopt new technology. In the twentieth century, the extension of the central government's power into new zones to the south and west has created substantial opportunities for impoverished northerners to migrate and to serve as soldier/settlers or even landlords. Unfortunately, in the postwar period, the bulk of highland farming expansion has taken

21 For an interpretation of the shift of capitals, see Donald Donham, "Old Abyssinia and the New Ethiopian Empire: Themes in Social History," in *idem* and Wendy James (eds.), *The Southern Marches of Imperial Ethiopia* (Cambridge, 1986), 3–48.

place into low-potential zones below the eastern escarpment where highlanders have had to adapt to new conditions. This movement to marginal lands has been a general trend from Eritrea south to northern Shawa. The evidence for this shift includes observations of spontaneous migration to previously uncultivated areas in eastern Wallo and Tigray, as well as along the western frontier with Sudan, all of which were traditionally used as wet-season pasture for lowland pastoralists. The resulting clash of political and economic interests has created an underlying conflict throughout this century. Although farmers have won these battles, the spoils have been of doubtful value: the much higher risk of drought and the variability of rains, especially spring rains, have imposed a fundamental limit on farm productivity.[22]

Ironically, population growth in areas of long-time settlement have, within the century, placed more pressure on capital resources than on land. Capital resources—seed, livestock, and tools—are those which disappear first during climatic or economic crises. Consequently, social institutions for the distribution of labor and capital have become increasingly important. In both northern Wallo in the 1920s and northern Shawa in the 1980s, local institutions for borrowing and transferring oxen and seed have been key to establishing local patterns of debt and dependency. The social institutions which link wealthy farmers to poor ones through accumulated debt have endured in form and function right through the twentieth century, although their effect is most graphic in areas of increasing population density and vulnerability to climatic variation.[23]

The evidence for social adaptation to new ratios of population to resources from the northern highlands is scattered but convincing. The Hobens, who worked in the Manz district of northern Shawa in the mid-1960s, observed the later stages of the

22 For Qobbo, see Assefa Bekele, Yitateku Negge, and Tewolde Gebre Egziabher, "Zobel: An Experiment in Relief and Rehabilitation," unpub. mimeo., Relief and Rehabilitation Commission (1974); for Sirinka (in southeastern Wallo) see Noel Coussins, "The Day of the Poor Man," unpub. mimeo., Drought Relief and Rehabilitation Commission (1975). The outbreak of raiding and conflict in the lowlands of eastern Tigray and Wallo from 1928–1930 (which culminated in the Ras Gugsa rebellion) was the result of conflict between new settlers and pastoralists. For an account of these events, see McCann. *From Poverty to Famine*, 146–168. See also note 36.

23 For a fuller description of capital in famine affected zones, see McCann, "Social Impact," 251–256.

repopulation of an area thinned during the Italian occupation. Those former residents who returned after 1941 found regenerated pasture and lower population density, approximating the historical advantages of movement to new zones and the beginning of a new agrarian/demographic cycle. Bauer's evidence from eastern Tigray has shown how population pressure transformed land distribution from open-ended residence-based claims to a more restrictive rist-based system as density increased. From an earlier period, the population of Walqayt (a highland area on Eritrea's southwest frontier), thinned by the Mahdist invasions of the 1890s, responded to low population density by shifting its landholding system from claims based on membership in a descent corporation (rist) to a simple residence-based system. The labor shortage also stimulated the region's use of slaves and sharecroppers. Unfortunately, the innovation in uses of labor during declining population density has not meant a parallel innovation in the use of new technology during population expansion in the past century.[24]

CROPPING SYSTEMS According to available accounts, highland farming systems have not transformed themselves beyond the technology or the basic cropping systems of the nineteenth century. The wide variety of cultigens available across the highlands has provided a substantial basis for local adaptation, sometimes to the needs of subsistence and other times in response to market opportunities. In lowland cultivated areas, the traditional cereals (barley, wheat, and teff) have given way to sorghum and maize, which are less marketable but better adapted to short, unpredictable growing seasons. In the past decade, the move to more vulnerable land and the reduction in pasture for livestock have encouraged a dramatic increase in the cultivation of oats over barley and a general decline in barley overall. Local and regional shifts in crops have doubtless percolated through the rural economy as new crops have become available. Maize, a quick-maturing grain with low labor requirements, has been one example.

24 Information on the repopulation of Manz comes from personal communication from Allan and Susan Hoben on their fieldwork in Manz in the early 1970s. Bauer, "Land, Leadership, and Legitimacy," 218. For the social transformation that occurred in the Setit-Humera region as its population decreased, see Giovanni Ellero, "Il Uolcait," *Rassegna di Studi Etiopici*, VI/VII (1948), 108–109.

For the most part, however, new crops added to the existing mix represented minor adjustments to the needs of subsistence rather than major alterations in the basic farming system's allocation of labor or the use of tools.[25]

Neither have agronomic systems across the highlands remained either uniform or static. For example, farmers of the vertisol (black cotton soil) plains in adjacent areas of Shawa and Wallo, who, historically, have intermarried and have a common language, social institutions, and highland farming system, differ in their management of their soil's tendency to waterlog. In northern Shawa, farmers accept low productivity of their vertisol plots, whereas their compatriots in the more densely settled southern Wallo invest considerable labor in constructing broadbeds to drain excess water and achieve a significantly higher yield, an adaptation in response to population pressure. Farms in bottom lands around Debre Berhan have traditionally planted spring barley to overcome the soil's tendency toward frost and waterlogging during the main rains. Unfortunately, the pressure to occupy these marginal plots or to adopt vertisol broadbeds suggests an attempt to forestall a decline in production per capita rather than to increase it.[26]

In some areas during the period from the beginning of the postwar era until the early 1970s, the introduction of active urban markets has transformed small-farm market participation. The Ada district fifty kilometers south of Addis Ababa had long served as a source for high quality cereals for the urban market, and the farms of its mixed Oromo and Amhara population had been designated *madbet* ("kitchen") land to provision Menilek's court and even Addis Ababa's churches. Ada's proximity to the burgeoning Addis Ababa market, its rich soil, and stable climate promoted crop specialization in the postwar period at a level

25 Donald Crummey, "Ethiopian Plow Agriculture in the Nineteenth Century," *Journal of Ethiopian Studies*, XVI (1983), 1–24. Although discouraged by the Ministry of Agriculture, oats have become popular because they are resistant to waterlogging and frost and provide substantially better fodder for livestock. The statistical evidence for this shift in production/consumption is only now emerging. See Ian Watt, "Regional Patterns of Cereal Production and Consumption," in Zein Ahmed Zein and Helmut Kloos (eds.), *The Ecology of Health and Disease in Ethiopia* (Addis Ababa, 1988), 118.

26 See Oxfam America, *Ethiopia: Relief and Development* (Boston, 1988), 5. See also, Gryseels and Anderson, *Research*, 11–12. It is on such lands that oats are overtaking barley as a high elevation staple.

unprecedented in highland agriculture. By 1980, teff, a highly marketable cereal, represented 50 percent of the cereal grains produced, an increase from 35 percent in 1960. The specialization in teff, which was based on traditional technology and landholding, was a response to the growing urban market for high quality teff and the demand by urban elite landlords who owned Ada land that rents be paid in teff. In many cases teff never reached the market; landowning families stored it for household use and distribution in urban social networks. Despite the intensity of market involvement, however, the basic organization of production remained rooted in smallholder farms using animal traction, scratch plows, and family labor. Fertilizer and improved seeds were available only through very limited credit schemes that were largely unavailable to poor farmers.[27]

Despite evidence of adaptability in some cases, the overall trend for smallholder farms has been one of decline in resources per household and productivity per unit. The success story of Ada demonstrates the point well. The relatively high productivity of Ada agriculture in the postwar period attracted the interest of external aid agencies and private farming in the early 1970s. Their efforts to increase the use of fertilizer and improved seeds combined with the government's credit schemes, drove land prices up and attracted new tenants and land speculators. Thus, the effect of Ada's success has been negative for per capita production: in 1969 the average per household landholding was 3.5 hectares, and by the early 1980s it had declined to 2.0 to 2.5 hectares, with only a marginal increase in yield. At the same time, the trend in subdivision and fragmentation had decreased both fallow periods and available pasturage. The major shift to teff reduced the production of other grains, although there were slight increases in pulses, which rotated on teff plots.[28]

27 See *ibid.*, 12, which shows a consistent drop in wheat and other cereals from 1960 through 1980 and a slight rise in pulses. The latter is attributable to the practice of rotating pulses with teff. Assefa Mehretu, former head of the Institute of Development Research in Addis Ababa, argues that elite landholding families in postwar Addis Ababa rarely purchased teff; instead, they carried it from tenant lands to urban storehouses and distributed it to families from there.

28 It is important to note that the process of specialization antedated formal development programs and extension in Ada. See Raymond Borton et al., "A Development Program for the Ada District Based on a Socio-Economic Survey," unpub. ms. (Stanford Research Institute, 1969), 62–68. Landholding figures come from *ibid.*, 96; Gryseels and Anderson, *Research*, 11, 32.

The historical decline of land resources per capita throughout the twentieth century suggests a need to intensify cultivation across the highlands. Yet the record shows that intensification of labor has not made major changes in productivity or transformed farming systems. In the rainfed highlands, there are only a few ways in which increased labor will raise the agricultural yield—plowing and weeding—and demands for oxen and human labor in these periods restricts its availability. Moreover, traditional crops place limits on the capacity of additional labor to improve productivity. For example, teff yields increase with five rather than four plowings, but not with six; more weeding marginally increases a harvest, but the effect is inelastic.

USES OF NONFARM LAND: FORESTRY AND PASTURE The historical expansion of highland cultivation, although cyclical in terms of productivity, also brought with it permanent changes in the land. In fact, losses of nonagricultural land and its products—forest and pasture—have been key indicators of maturity in the demographic cycle. The ability of the state to expand its cultivable land resources through conquest has allowed problems of population pressure on land to be resolved by out-migration before decline in productivity and returns to labor reached a critical stage. The depletion of nonfarm resources as a by-product of highland farming systems accounts not only for the local impetus to support state expansion but also for the weakness of local economies during historical periods when state power was weak. The closing of the frontier by the modern state, beginning in the 1920s, and the general population increase since then have dramatically altered the northern agrarian scene. Pastoral landscapes painted in by Henry Salt in the early nineteenth century bear little resemblance to present conditions.[29]

Historical data on the decline of forest resources are scattered but convincing. The forested area of Ethiopia as a whole has declined from about 40 percent in the early twentieth century to about 4 percent today. Most of that decline, evident for some time, has taken place as a direct consequence of the expanding agricultural activities in the highlands resulting from the need for

29 Another indicator of the mature stage of the agrarian cycle is the establishment of trees and pasture (or fodder) as private property.

more cleared land and fuel. Charles Beke, in 1843, noted the sharp contrast between settled eastern Gojjam and the relatively newly settled Damot area to the west; today, natural forests are virtually absent in both sections of Gojjam, where forested land has declined to .7 percent of the total area. Carlo Annaratone, who traveled south from Koram in 1911, was more interested in politics than agriculture, but he did report abundant firewood along Wallo's eastern escarpment—an area that in the past decade has been devoid of trees, but full of cultivators. Today, forests account for only .3 percent of Tigray's land.[30]

The loss of uncultivated land resources has not been restricted to the northern highlands. In Wubera, old Hararge residents can name a number of now-absent primary tree species and point to valleys which were forests in their childhood but have since succumbed to the plow. The result of this change has meant a decline of wood fuel, a gradual shift to dung fuel, and a consequent increase in women's labor to supply household fuel needs. By 1980, farm households in Ada and in Debre Berhan burned four times more dung by weight than wood.[31]

The overall loss of forage and pasturage to cultivation has had a similar, if more direct, effect on productivity since it affects the supply of oxen, a major capital resource. In areas of increasing population density, pasture has steadily declined relative to livestock needs. The changes in the amount of available pasture in the highlands are evident in Crummy's observation that nineteenth-century travelers reported highland pastoralists in Tigray, Gojjam, and Shawa, areas intensely cultivated today. By contrast, recent oxen per household figures from Simen, norhern Shawa, Ada, Gojjam, and highland Hararge all show a fundamental shortage of traction animals. Although we have no conclusive statistical

30 Gryseels and Anderson, *Research*, 10. Even more convincing are forestry data which show northern provinces account for only 4.1% of Ethiopia's forested area but contain 37.2% of its cultivated area. See Daniel Gamachu, *Environment and Development in Ethiopia* (Geneva, 1988), 7. Charles Beke, "Abyssinia—Being a Continuation of Routes in that Country," *Journal of the Royal Geographic Society*, XIV (1844), 3. Carlo Annaratone, *In Abissinia* (Rome, 1914), 121.

31 For a comprehensive study of agroforestry and farming systems, see Peter Pochen-Eiche, "The Application of Farming Systems Research to Community Forestry: A Case Study of the Hararge Highlands, Eastern Ethiopia," unpub. Ph.D. diss. (Albert-Ludwigs Univ., 1986). In ILCA research areas at Debre Berhan and Debre Zeit, the use of wood as fuel has declined to approximately one fourth of the total fuel source. Gryseels and Anderson, *Research*, 10.

data for the pre-1960 period, recent evidence suggests strongly that the expansion of cultivable land correlates directly with a reduced capacity to support an adequate population of cattle and oxen.[32]

The historical link between demographic density and a reduction in the holdings of oxen and other livestock is persuasive if not conclusive. The trend has been a gradual one associated far more with the loss of pasture than with short-term shocks from drought or disease. That it is most advanced in areas of long-term settlement suggests a cumulative rather than a recent process. A longitudinal study of Simen describes in detail the process of pasture loss and indicates that by 1975 the average household owned less than a pair of oxen. In Tegulet, where density has increased steadily during this century, farms in the last few generations have incorporated cows as traction animals because of the shortage of oxen. Even in the high-production Ada region, the average number of oxen per household declined from 3.21 in 1969 to 1.86 in 1980, indicating an acceleration of the historical process. Overall, the evidence on the decline of oxen holdings and pasture strongly suggests both a relative decrease in the numbers of animals available per farming household and, in most areas, an absolute decline in the number of animals supported locally.[33]

Forests and pastures share their vulnerability to expanding cultivation but differ in their potential for regeneration. Open pasture can recover within weeks after a drought or in a season or two as fallowed cropland. Trees, once cleared, have a much longer cycle of recovery, and most indigenous primary species have permanently disappeared from the rural scene except in isolated, ritually significant locations. Fast-growing eucalyptus trees, imported by Emperor Menilek from Australia in 1895, have helped to meet urban fuel needs, but have failed to regenerate

32 *Ibid.* My surveys in both northern Shawa and Wubera, Hararge, show that the average ox/household holding has fallen below a pair per household. See McCann, "Social Impact," which includes data from ILCA and Ministry of Agriculture surveys. Crummey, "Ethiopian Plow Agriculture," 4–5.

33 I have drawn these comparative statistics from two separate surveys. See Getachew Tecle Medhin and Telahun Makonnan, "Socio-Economic Characteristics of the Central Highlands of Ethiopia—Ada Weeda," unpub. report, Ministry of Agriculture (Addis Ababa, 1974), 26; Gryseels and Anderson, *Research*, 14. For oxen data, see also Messerli and Aerni (eds.), *Simen Mountains*, 58; McCann, *From Poverty to Famine*, 80.

forests. In both cases, the recovery can take place with a decline of demographic pressure, but in the case of forests, only as secondary growth.

FEEDING THE STATE: PRODUCTIVITY AND THE POLITICAL DOMAIN

The expansion of central state authority over local prerogatives in northern Ethiopia has been a dominant historical theme from 1889 through the twentieth century. The overriding feature of politics and peasant agriculture during the course of the twentieth century has been the expansion of the state's willingness and ability to affect the nature of production at the local level. Through most of Menilek's reign (1889–1913), the central government was severely restricted in its ability to extract revenue from and otherwise affect the local process of agriculture. Its ability to overawe or suppress opposition militarily was restricted to one or two areas at a time, the effect being as much symbolic as real.[34]

When Ras Tafari emerged as regent in 1916, trends on the national scene radically altered the political and economic climate of Ethiopia's northern and central provinces. State intervention in local political economies began in earnest in the early 1920s; at the center were the fiscal policies initiated by Ras Tafari (crowned Haile Sellassie I in 1930), as well as those introduced by members of the regional elites, such as Ras Hailu in Gojjam, Ras Kassa in Wallo, and Rases Siyum and Gugsa Araya in Tigray. In the half decade following his coronation and preceding the Italian occupation, the emperor systematically reorganized customs collection, appointed loyalists to regional offices, and began fiscal reforms to undercut the prerogatives of the local elite. The subsistence-oriented northern highlands participated only marginally in the new national political economy.[35]

34 The shift of the tithe from church to local military control was a notable exception, although its implementation was sporadic. See Joanna Mantel-Niecko, *The Role of Land Tenure in the System of the Ethiopian Imperial Government in Modern Times* (Warsaw, 1980), 208–209.

35 The crushing or subjugation of elite opposition in the north proceeded with the downfall of Ras Gugsa in 1930, Ras Hailu in 1932, and Ras Siyum in 1932. The method differed in each case but the end result was the further extension of central government power. Control over key areas like Hararge and Shawa had taken place much earlier. For accounts of this period, see Harold G. Marcus, "The Infrastructure of the Italo-Ethiopian Crisis: Haile Sellassie, the Solomonic Empire and the World Economy, 1916–1936," in

Regions on the southern and western periphery of Addis Ababa, which were dominated by imperial loyalists and northern soldier/settlers, began to produce extractable and exportable wealth—coffee, hides, and gold—whereas the north offered only limited quantities of subsistence crops. Predictably, investments in roads, foreign concessions, credit, and cash crops expanded rapidly in the south before, during, and after the Italian occupation (1935–1941). Although migrants from northern rural areas continued to move into these areas of growth, the once-open frontier closed. Policies emanating from the new political center reflected national priorities for development, not the emerging crisis in the rural economy of the north.[36]

Specific aspects of centralization and the expansion of state authority affected agricultural production at the local level. Shifts in fiscal policy from proportional to fixed tax assessments and from in-kind to cash payments challenged the basis for subsistence strategies. Officials of the state not only collected the *asrat* (tithe) to fill its local granaries, but also required additional payments of fixed taxes and special collections in cash. The effect of the increased state presence appeared most dramatically in the state's ability to organize and centralize customs collections, a traditional prerogative of the local and regional elite. Revenue lost to the rural elite could be recovered only by the more rigorous exercise of exactions on local agriculture. That many of Ethiopia's regional elites had become urban residents and investors only increased their need for cash payments from their local constituencies.[37]

Evidence on the effects of such stress on smallholder farms is scarce and must be drawn primarily from recent experience. My own observations of farm strategies under stress indicate that

---

Proceedings of the Fifth International Conference on Ethiopian Studies(Chicago, 1979), 559–568; McCann, *From Poverty to Famine*, 127–172.

36 For an excellent study of a southern area's incorporation into the Ethiopian Empire, see Charles McClellan, *State Transformation and National Integration: Gedeo and the Ethiopian Empire, 1895–1935* (East Lansing, 1988).

37 For a description of the relative effects of fixed over proportional payments, see James Scott, *The Moral Economy of the Peasant: Rebellion and Subsistence in Southeast Asia* (New Haven, 1976), 53. Hailu is the most often cited example of an urban entrepreneur, but by 1930 Ras Kassa, Wagshum Kabbada, and many others had established a firm financial presence in Addis Ababa and in regional capitals. Running such elaborate households required not only food and labor, but also, increasingly, cash. For a good description of life at court in Addis Ababa, see Marcus, *The Life and Times of Menilek II: Ethiopia, 1844–1913* (Oxford, 1975), 218–225.

fixed tax demands during crisis or recovery often result in further capital disinvestment (selling of oxen or farm implements), the expansion of debt, and increased dependence on off-farm income. In northern Shawa in 1985, for example, drought-stricken farmers in a remote district were required to pay a land tax, a drought tax, and special fees. Faced with the prospect of losing access to land for nonpayment, most farmers chose to decapitalize their farms (by selling oxen, seed, and tools) to meet the tax burden. The peasants' decision to liquidate assets reflected a farm-level economic decision similar to that chosen by highland farmers faced by declining production two or three generations ago. Even though the postwar state has a capacity to enforce tax payments beyond that of the past, this process of change has been a gradual one for which the 1920s and 1930s were as important a watershed as the 1970s.

Capital disinvestment on the farm has been examined recently as an issue of famine response. Yet, the stress of famine conditions is only one type of crisis resulting in decapitalization of small farms. Farmers' decisions to disinvest in agriculture and liquidate capital assets over the short or long term can also be a response to the political climate. Wallo farmers during the 1928 to 1930 Ras Gugsa Wale rebellion, for example, sold off stocks of grain at well below market price to avoid its appropriation by roving bands of rebels and government troops. The conditions for such actions have existed at several points over the course of the twentieth century because of the persistence of political instability.[38]

The resistance of local interests to the expansion of state power has resulted in a persistent pattern of local and regional rebellions and military campaigns aimed at suppressing them. Between 1898 and 1945, at least nine major campaigns lasting from several months to several years have taken place in the northeastern highlands. Resistance has generally taken the form of elite-led rural rebellions aimed at forestalling the loss of local

38 Cutler has looked carefully at the relationship between grain and livestock prices during drought and at the timing of oxen sales during crisis. Peter Cutler, "Famine Forecasting: Prices and Peasant Behavior in Northern Ethiopia," *Disasters*, (1984), 48–56. For nonfamine causes of decapitalization, see Bauer, *Household and Society in Ethiopia* (East Lansing, 1977), 92–94. For peasant grain sales, see Corrado Zoli, *Cronache Etiopiche* (Rome, 1931), 329.

income and political power. Until the mid-1970s, the central state won the day at every turn, allowing the consistent expansion of its policies of taxation and customs control, and the increased presence of state officials. The centralization of state prerogatives and resistance in such areas of Tigray and Eritrea since 1974 is an extension of a much broader trend, although recent success at suppressing local resistance has diminished considerably.[39]

The effect on local productivity of the frequent military campaigns and calls to arms through this century is a point of debate. Beyond consuming food supplies and confiscating traction animals, the armies on all sides recruited and attracted young male labor away from the drudgery of farm work to the excitement of military action, both for and against the central government. The loss of young men and women to local movements of resistance is therefore not a new phenomenon. Nor is the exodus of northern Ethiopians across the Sudan border to seek off-farm work and safer political conditions. Throughout the 1920s and 1930s, a steady flow of migrants and refugees form Eritrea, Tigray, Gondar, and Gojjam provided seasonal wage labor in the developing Sudanese agricultural economy near the border. As many as 100,000 young men from Eritrea and northern Ethiopia joined the Italian forces in Libya as soldiers—a form of target labor—between 1911 and 1932. Such phenomena are far more the result than the cause of productivity decline.[40]

Global subsistence crises in peasant societies emerged along lines defined by distinct historical circumstances. In general terms, there is a juxtaposition of regional rural economies, in which productivity has been historically declining, with rapidly growing urban zones and market-oriented agrarian economies, in which

39 The chronology of these events derives from monthly and sometimes daily reports from British, Sudanese, and Italian sources, as well as local oral tradition and eyewitness accounts. For a narrative account, see McCann, "Households, Peasants, and Rural History," 145–197. For Tigrayan evidence, see Gebru Tareke, "Peasant Resistance in Ethiopia: The Case of Wayane," *Journal of African History*, XXV (1984), 77–92.

40 See Richard Caulk, "Armies as Predators: Soldiers and Peasants in Ethiopia c. 1850–1935," *International Journal of African Historical Studies*, XI (1979), 457–493. Caulk points out the effect of military activity on specific areas, but never addresses the impact of military action on overall productivity. Data on monthly border crossings were kept by Sudan district commissioners in Kassala, Blue Nile, and White Nile provincial records. See the INTEL files and *Sudan Monthly Record* files housed at the National Record Office, Khartoum. For wage-labor migration, see McCann, *From Poverty to Famine*, 185–193.

rapid accumulation and a secure food supply have been possible. In Ethiopia, economic divergence in the postcolonial era has followed a north-south axis, with famine zones concentrated in those areas historically least penetrated by international capital and external forces of change. Their failure has been the result not of their direct subordination to international markets or extraction by absentee urban landlords, but of their inability to break out of the inertia of the agrarian cycle.

In Ethiopia, the issue has not been the farming system's lack of resiliency—it has endured and expanded for more than a millennium—but its failure to break the technological impasse as demands on it have changed. The growth of urban centers of consumption and centralized political power since the 1920s has placed additional demands on production but failed fundamentally to transform the basis of agricultural productivity. The dramatic breakthrough in the state's ability to affect agrarian policy and to extract resources from rural areas—which began in the 1920s and continued with programs of resettlement and the creation of villages in the 1980s—has not resulted in a parallel breakthrough in new gains in productivity at the farm level.

In Ethiopia's case, there have been specific political consequences. The 1974 revolution was in many ways a response to the state's long-term failure to transform agrarian production in the 1960s and early 1970s. The result of state policy—if not the intention—since 1974, however, has not been to increase productivity in famine-prone areas through rural investment but to insure that urban centers of power have access to food from surplus production areas where climate has been favorable and the "Malthusian scissors" have yet to close.

To understand crises of subsistence, it is necessary to examine them both as products of their historical and political contexts and as phenomena in which the internal dynamics of particular rural economies are critical. Since it is not necessarily possible to draw generalizations from an individual case, this examination of Ethiopia's agrarian cycle has value as much for its implicit method and approach as for its conclusions. An agricultural historiography which is sensitive to social institutions, which uses a broad range of sources, and which is aware of the technical issues of rural economies will be an essential tool for illuminating the consequences of individual subsistence crises and for building broader, historically based generalizations.

Senator GORE. Just a brief aside on coffee. Is the Ethiopian highlands the area of origin for coffee?

Mr. MCCANN. It seems it may be so, especially the Kefa region. We have more varieties of coffee in that area than in any other part of the world. And there is significantly more wild coffee.

Senator GORE. You are familiar with the Vavilov region?

Mr. LEGESSE. Right, Vavilov. There is an abundance of evidence on the number of wild species of coffee that exist only in Ethiopia, southwest Ethiopia.

Senator GORE. One of the world's 14 or 15 Vavilov regions is in the Ethiopian highlands if I am not——

Mr. MCCANN. That is true in general.

Senator GORE. I understand that there are a number of species that originated in the highlands. To what extent do coffee growing nations around the world replenish their stock of coffee gene diversity by revisiting the highlands periodically? Do any of you know that?

Mr. LEGESSE. They don't. There has been no work done on the diversification of the genetic basis of coffee by using the wild varieties that are present in Ethiopia.

Senator GORE. I have some anecdotal evidence to the contrary. It may not be reliable, but I have been told by plant biologists that there have been some repeated visits by coffee growers from Brazil, for example, to collect specimens of wild varieties to replenish the diversity and resistance to disease of domesticated coffee varieties. It is an aside, but an interesting point about the richness and heritage of the highland area.

Mr. MCCANN. Just to add to that, the important point that led to the wild coffee and certainly the penultimate generation of cultivated coffee disappearing quickly as a result of coffee berry disease.

Senator GORE. Yes.

Mr. MCCANN. CBD, which accounts for the precipitous drop in coffee production since much of the production in this one area I cited is still based on the collection of wild coffee. This is worrying.

Senator GORE. There has been much talk in the ecological community around the world about invalid diversity convention although that is not directly on point here today, it is worth mentioning in the hearing record because the ecological damage which has contributed to the famine can be seen in a variety of different ways. You said, Mr. McCann, that your area of expertise is in climate history, among other things, agriculture and climate.

Mr. MCCANN. Ecological history which must include climate.

Senator GORE. To what extent do you believe that deforestation in recent decades has accentuated the severity of the recent droughts?

Mr. MCCANN. I don't think it has had an effect on drought per se as purely a climatological phenomenon, but it certainly has had an effect on the agricultural manifestations of that since deforestation, as Mr. Legesse pointed out, has an effect on soil moisture, retention capacity, a whole range of corollary effects. I don't think that there's any good evidence of the relationship between deforestation and rainfall because at least in the case of the Ethiopian highlands we have not had—even though there were some forests available, it

was not the kind of dense rain forests that has that cumulative effect that we see in Latin America or in Central Africa.

Senator GORE. Do you know of extensive deforestation upwind that might have had an effect on rainfall recycling?

Mr. MCCANN. Excuse me.

Senator GORE. In some areas droughts have prolonged deforestation upwind when prevailing winds used to—when prevailing winds carried the transpiration and evaporation from forest lands downwind and caused rain downwind from the forested areas. Sometimes when those forests are eliminated the winds no longer carry the moisture and the downwind areas suffer drought. Is this a phenomenon that has any bearing in a discussion of Ethiopia?

Mr. MCCANN. If we take northern Ethiopia, leaving aside the very dense primary forests that still do exist in the southwest, the forests of areas that existed there historically and the places where it did not exist—it did not exist everywhere—were not sufficiently dense to produce that effect. But that is speculation. I think we simply need more environmental history related to specific agricultural problems.

Senator GORE. There was a recent study showing the shift of the isohyets, the climate patterns from rainfall in the Sahel to rainfall in Central Europe; are you familiar with that study?

Mr. MCCANN. Not that one necessarily, but similar ones that relate to African rainfall to other phenomena.

Senator GORE. Let me shift gears and shift to what I think is the central thrust of my questions to this panel. One of you said the question is—and I think it was you again, Mr. McCann—when conditions change we need to know when, where, and how to make investments in sustainably productive agriculture. Let me ask you about some premises, how that might be done.

First of all, would it make sense to concentrate on small holders by giving them the essential help required to buy the time and elementary inputs, to turn around the production capacity and margins of return and investment? Can we agree that investments ought to focus on efforts to empower and enable small holders? And if possible, I would like short answers to this series of questions. If you must elaborate, we will make time for it. But can we agree on that much?

Mr. LEGESSE. I would say that I would agree with that wholeheartedly, and I was a participant recently in a conference that was held by African Development Foundation of African Livestock Breeders from across the continent, and one of the common characteristics for all of them was that they had designed their projects, they helped run it and therefore there is a degree of commitment to the project that is quite extraordinary. So, I think that kind of an element of grassroots planning makes a big difference as to the success or failure of the projects.

Senator GORE. Nobody disagrees with that?

Mr. ANTOINE. No.

Mr. MCCANN. No.

Senator GORE. All right. Now, can we agree that we should concentrate in any such investments when the time is right on a number of measures, including—and I am going to list several—the

control of water runoff and the preservation of moisture in soil by terracing and ridging?

Mr. McCann. Let me say that I think from my own point of view, yes, prevention of soil runoffs and erosion is a problem. But when you have extremely small farms, small farms getting to below one-half hectare to put a soil bound on a farmer's field means that he is giving up several meters of land. And I have not yet seen evidence that it really does improve short-term productivity.

Senator Gore. Do you disagree we should concentrate on control as the preservation of moisture and the control of water runoff?

Mr. Antoine. May I offer he and I are somewhat in disagreement with you. The two countries in Africa with the highest density of populations are Burundi and Uganda, and the average size of a plot there is smaller than in Ethiopia even. And those measures have been fully supported by the Government and by a variety of donor agencies, and they work very well. The farmers are even stealing the recommendations at times. You can avoid losing land and space with some appropriate technology using grass and all sorts of things. So, I would say yes to your question and somewhat disagree with your statement.

Mr. McCann. It is a different agricultural system, a much higher density of perennial crops. I don't necessarily disagree, but I think we have to be careful about assuming that that is a given.

Senator Gore. The preservation of forested hillsides and grazing lands, should this be a focal point?

Mr. McCann. Yes.

Senator Gore. No one disagrees. The development of small-scale water resources, especially ponds; does anyone disagree?

Mr. Legesse. I think that is critical. I think that really is a departure from the typical pattern of development that has occurred in recent cases.

Senator Gore. Increasing soil fertility——

Mr. McCann. To add to that and maybe you did say it—management and maintenance of. Eighty percent of the hand pumps put into Ethiopia by the Water Resources Authority do not work today. Maintenance is absolutely critical.

Senator Gore. Improving soil fertility through animal dung, currently often used in the absence of wood for fuel, composting and possibly the use of chemical fertilizers.

Mr. Antoine.

Mr. Antoine. I consider fertility as a priority. I think at some stage we have to use the chemical fertilizers, but in the short-term and medium-term horizons I believe that we have to find a compromise between the biological and chemical inputs.

Senator Gore. If we concentrate on these four methods of land reclamation and improvement and if we focus development strategies on the empowerment and enabling of small holders, what do you think of a technique that focuses on providing capital in the form of money and/or food to pay the farmer, the small holder himself, while these land reclamation improvements are underway? And utilize cooperatives—first of all, let me ask about that, about that particular strategy.

Mr. ANTOINE. I think that an interesting analysis could be made of the experiment started by former President Jimmy Carter in Global 2000. It takes place in the Sudan and Ghana and is successful in Ghana as compared to the other countries. Borlau told me that the reason they thought the program was successful was that the capital that was given to the farmers was given on a loan basis and was not a gift. He really stressed the importance of this and he feels that it is an excellent idea.

Mr. MCCANN. One issue about the reclamation work that is very important is that it is the basis upon which future development can take place. But the danger is providing a food-for-work project or a cash-for-work project on a local community, one of the reasons it has happened in farming systems I have worked with in Hararghe is that farmers then begin to take those wages as part of their ongoing income and therefore disinvest in their agricultural enterprise. It is not unlike opening a small factory in a small town. People will move off the farm and start working in the factory. It must be built in as part of a planned system in which farmers know that there is a beginning and an end to the investment. That is essential.

Senator GORE. What do you think about utilizing cooperatives as organizational modus for this kind of intervention?

Mr. LEGESSE. I would like to make a comment on that. That did turn up actually on one evaluation which I did for the Government of Ethiopia in 1973. A cooperative was created by the Government and installed, and it was not really recognized or accepted by the people. And they proceeded to create another organization which they called the Field Committee which effectively became the cooperative. So, in a sense where the cooperative comes from and the extent to which it ties into the indigenous institutions is what will make it survive and function.

Senator GORE. So, you agree with that?

Mr. LEGESSE. I agree with the idea of having cooperatives, but only if they are tied to existing institutions.

Mr. MCCANN. I agree very much, and I think Mr. Legesse knows the local institutions. One important difference—not difference with you, but the issue of whether or not to use existing service cooperatives in Ethiopia as a structure. My sense is the initial optimism about the use of these structures for—bottom-up kinds of development—has not taken place. And so there will have to be a new structure of cooperatives within Ethiopia. Those have been too often used by the Government as tools of their local policy. Farmers will not trust them. There has to be a new structure. They should not be government sponsored, as far as I am concerned.

Mr. LEGESSE. There is a bible handed out for cooperative development and they go around and put those in place with no feedback from people. And so in the end, the Government sponsored cooperatives become dysfunctional and something else is created in their place.

Senator GORE. I would note for the record that we have a law called the Microenterprise Act involving microenterprise loans that could be applied to exactly the kind of development strategy, at least insofar as the U.S. role is concerned. That would focus on providing loans in small amounts, very tiny amounts, to put capital

and/or food in the hands of small holders to provide the empowerment and enabling necessary for them to improve agricultural productivity within the context of the effort of a larger strategy, emphasizing and encouraging the control of water runoff, preservation of moisture and soil with techniques such as terracing and ridging, preservation of forested hillsides and grazing lands, development of small-scale water resources especially ponds with attention to the ongoing maintenance of those ponds and improvements of soil fertility through animal dung and composting possibly at some point in the future including also some chemical fertilizers.

It seems to me, and if you wish to provide further comments for the record after reflecting on this proposal, we would welcome your ideas and thoughts. But it seems to me that after hearing the testimony today from all three panels that in the future when the conditions are right to address the long-term chronic problems that are now being seen as another cycle begins in Ethiopia, this kind of strategy might make a great deal of sense. And again, I invite the witnesses on this panel and the other two panels to comment for the record on the proposal as outlined.

We may have some questions in writing.

We have run out of time partly because we have to vacate the room. But I want to close by expressing my thanks to all of the witnesses who have joined us today. It has been a very interesting and I hope productive hearing. I have learned a great deal. And the committee, which has a longstanding interest in sustainable agriculture, has benefited from the testimony all of you have provided. This will be a continuing focus of activity. I hope that we will soon find the correct conditions for beginning to implement these measures on a wide-scale basis. Thank you all very much.

[Whereupon, at 12:07 p.m., the committee adjourned, subject to the call of the Chair.]

[The following written questions and answers were subsequently supplied for the record:]

RESPONSES OF PIERRE ANTOINE TO WRITTEN QUESTIONS

Winrock International
WINROCK INTERNATIONAL INSTITUTE FOR AGRICULTURAL DEVELOPMENT

Headquarters:
Petit Jean Mountain
Morrilton, Arkansas 72110, USA
Telephone (501) 727-5435
Telex 910-720-6616 WI HQ UD
DIALCOM 41:TCN400
FAX (501) 727-5242

March 9, 1990

The Honorable Al Gore, Jr.
U. S. Senate
Washington, DC 20510

Dear Senator Gore:

It was indeed a pleasure and an honor to be invited to participate in the Joint Economic Committee hearing on Ethiopia on February 27, 1990. I hope that you will be able to find specific solutions to the problems faced by that country.

You will find enclosed an updated and revised copy of my testimony before Panel III, and an answer to the Ethiopia hearing questions you sent by mail.

Please do not hesitate to contact me, or my Winrock colleagues, if you need any additional information.

Sincerely yours,

Pierre Ph. Antoine
Acting Regional Director
Africa and Middle East

jf

Enclosures

c: R. Havener, President
D. Athwal, Senior Vice President

Responses to Ethiopia Hearing Questions

"Towards a Strategy for Sustainable Development"

Pierre Antoine
Acting Director, Africa and the Middle East
March 9, 1980

1. Potential for a "Green Revolution" based on bio-technology in Ethiopia:

Considerable potential exists for dramatic gains in Ethiopia's agricultural production. These gains, however, will probably be achieved not through bio-technology or "new" technologies, but through increased use of existing technologies and reform of policies and institutions. There are few bio-technologies that are currently of much value for agriculture even in the United States and other rich countries; Ethiopia will probably derive little benefit from bio-technology for a considerable number of years.

The exception to this statement might be the use of bio-technology for livestock breeding and husbandry. New technologies like embryo transplantation can speed up the breeding of improved animals. Similarly, scientists are learning to isolate genes for disease and pest resistance. These techniques can help them develop new and cheaper vaccines. In addition, genetic modification can be used in breeding programs to develop animals with resistance to particular diseases.

For the most part, however, simpler tools will have a greater and more immediate impact on Ethiopia's agriculture. The use of fertilizer and other inputs, existing crop varieties, improved post-harvest practices, and other available technologies can probably double current production levels. These technologies must be reinforced by policy reforms, education programs, and improved extension efforts.

Finally, it is worth noting that the original "Green Revolution" in Asia was primarily limited to irrigated areas with alluvial soils and good access to roads, markets, and other infrastructure. Comparable areas in Ethiopia are limited at present. Agricultural production and technology adoption will be greatly enhanced through investments in irrigation and infrastructure, to the extent that resources are available for these costly undertakings.

2. Role of Different Technologies:

Ethiopia is a country with enough diverse agroecological zones that it is difficult to generalize much about which technologies will be useful in which parts of the country. Useful technologies might range from irrigation systems in the drier lowlands to terracing and contour planting in the highlands. Local research stations are best equipped to diagnose farm-level problems and appropriate solutions.

On the basis of our experience elsewhere in Africa and the developing world, however, we suspect that a few broad statements can be made. For example:

-- Large-scale irrigation projects have been extremely costly in much of Sub-Saharan Africa. Management of these systems has also been problematic, since large central bureaucracies are generally needed to manage and administer big irrigation projects. On the other hand, these irrigation systems can succeed in raising production levels and benefiting large numbers of farmers. Examples of reasonably successful large irrigation projects in Africa include the SEMRY Rice Project in Cameroon, the Office du Niger in Mali, and arguably the Gezira scheme in the Sudan (although all of these projects also have their critics).

   An alternative to large-scale irrigation systems is the promotion of tubewell irrigation under private-sector ownership and operation. Individual farmers and small cooperatives can own and manage tubewell systems, which have shown high levels of efficiency. The vital constraint here is in providing power and infrastructure to support tubewell pumps and to decrease transaction costs. Comparable systems of private-sector irrigation have flourished in Bangladesh and the Indian Punjab.

-- Large mechanized farms can play an important role in expanding production. Under some conditions, mechanization can play a vital role in expanding production. In general, however, large farms do not have any monopoly on efficiency of production or high productivity levels. Mechanization should not be confused with productivity. For the most part, these farms will prove most viable in areas that are geographically appropriate -- near roads and population centers, with well-developed markets for both inputs and outputs.

-- Small-scale farmers and the traditional farming sector will continue to play a crucial role in Ethiopian agriculture. One reason for their importance is the sheer size of these groups within Ethiopia's population. Nearly 80 percent of Ethiopia's labor force works in agriculture, and 50 percent of GDP is based on farm production. At present, large farms account for a very small proportion of the country's agricultural production. Average farm size is around 1.0-1.5 hectares.

   For the foreseeable future, then, small farms and traditional systems will account for the bulk of

Ethiopia's agricultural production. Perhaps more important, these people also account for the bulk of the country's food consumption. Agricultural development programs must meet the needs of these people if they are to prevent famine and starvation.

These smaller farmers need access to inputs, training, infrastructure and incentives. Around the world, peasant producers have shown that they are capable of achieving high levels of productivity under appropriate conditions. Ethiopia's future agricultural development will depend on the successful mobilization of this small-farm sector.

3. Production Instability and Grain Stocks:

Given the nature of Ethiopia's climate, production variability will remain a constant problem. This variability -- and the related risk of financial loss, which discourages input use -- can be lowered significantly through expansion of irrigated area. But Ethiopia will remain susceptible to production swings.

One way of minimizing the effect of these production swings is through maintenance of buffer stocks or inventories. National governments can hold considerable stocks, but the cost of storage is fairly high, and distribution problems arise in times of shortage. Perhaps a better solution is to promote improved on-farm storage and village-level schemes. Even in normal years, crop losses due to poor storage are high, and improved storage systems would thus provide continuing benefits.

Ultimately, the most dependable buffer against variability is trade -- intraregional, interregional, and international. Trade spreads the production risk over larger areas, and high-variability countries stand to gain considerably from trade in agricultural commodities. Ethiopia will need an improved internal distribution system, however, if it is to rely on trade as a source of food security. Imports of food through Assab, Massawa, or Djibouti will not reach villages in Wollo without effective marketing and distribution networks. Private sector domestic trading would be needed if Ethiopia is to rely on international trade for food security.

4. Concentrating Agricultural Development:

The areas with greatest potential should be the focal points for initial development activities. Production increases here can help alleviate the most pressing problems of poverty and hunger. In addition, scarce development funds can have their maximum impact if they are focused in specific areas, which can be thought of as growth centers. Following this approach, specific areas would be selected as initial target zones for intensive development of irrigation, infrastructure, and soil improvement programs.

Selected first would be the easiest areas -- those with good initial endowments of resources, access to markets, reasonable infrastructure, and high irrigation potential. From these "first-order" centers, development could spread to secondary centers located at some small distance. The primary and secondary centers would be linked by transportation and communication facilities. In this way, the growth centers would develop symbiotic trade relationships, and trade would stimulate growth in regions between the centers.

Marginal areas should not be overlooked, however. These areas exhibit some of the worst problems of persistent poverty; they are also highly susceptible to environmental degradation. Appropriate programs for these areas might focus on resource conservation and poverty alleviation.

5. Development of New Lands:

Initial development efforts should focus on expanding the productivity of existing lands in agriculture. Since there appears to be considerable potential for dramatic production increases on existing land, there is no pressing need for expansion of agriculture onto "new lands."

In any event, new lands are seldom actually "new." These lands are generally in use already -- for herding and ranching, or for subsistence cultivation. The development of these new areas would threaten to dislocate poor people as well as to cause environmental degradation. Other options should probably be explored before efforts should be spent on opening these lands for development.

○