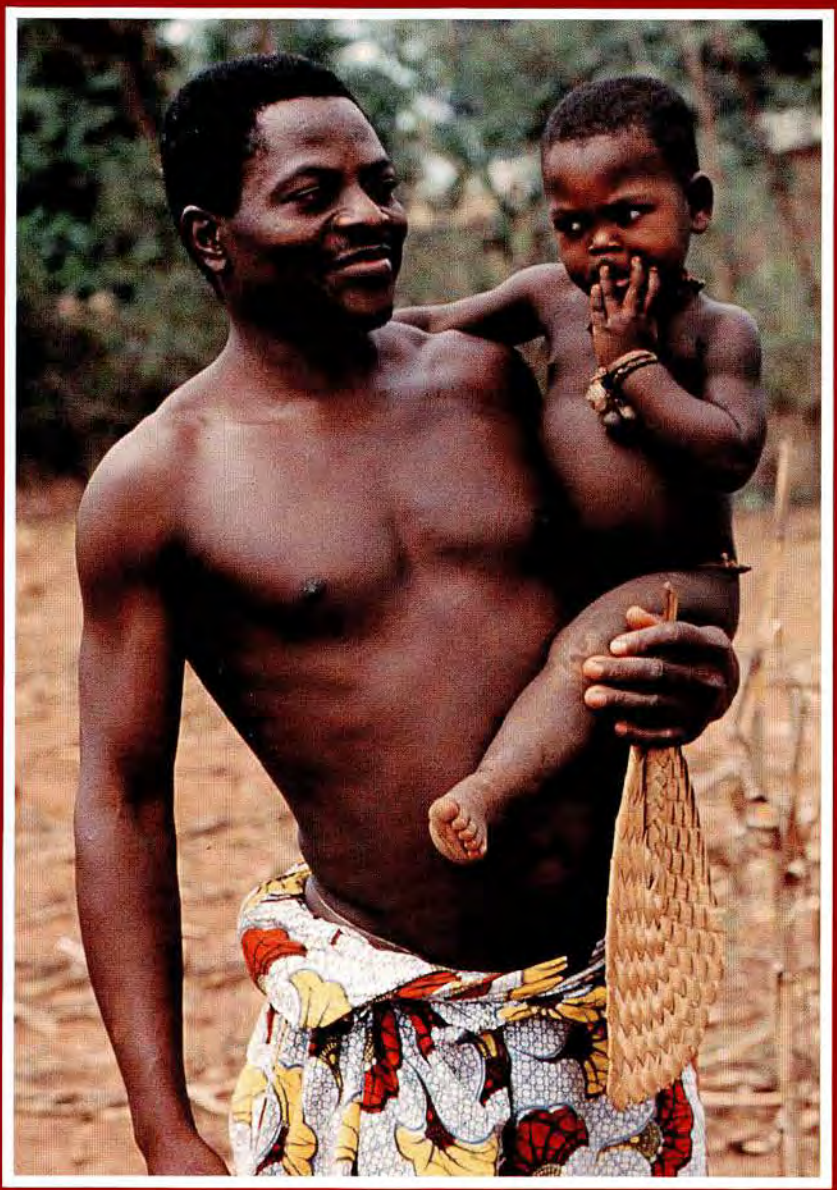
Developing African Agriculture: New Initiatives for Institutional Cooperation

SAA/Global 2000/CASIN



Developing African Agriculture: New Initiatives for Institutional Cooperation

SAA/Global 2000/CASIN

Editor
Wayne E. Swegle

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Abstract: This publication provides a record of the seventh in a series of workshops that have examined measures for helping sub-Saharan Africa countries achieve greater food security as well as other topics related to the continent's development. The papers presented here cover a wide range of issues, including strategies for modernizing agriculture, with emphasis on increasing production by smallholders; intensifying production on favored lands while reducing farming pressure on fragile ecologies; strengthening technology delivery systems; increasing support for women farmers; building the rural infrastructure, including roads, power, and water; balancing the public and private sectors to capture the benefits of privatization; and integrating small farmers into the commercial agriculture sector.

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Preface

Jean F. Freymond
Director, CASIN

In 1984 a number of countries in Africa were in the grip of famine. Response was quick, first in the form of famine assistance, later projects. The Sasakawa Africa Association (SAA) was born from the tragic images that appeared on television. Since 1986, by means of pilot projects set up in cooperation with Global 2000, SAA has endeavored to translate increased food production from the realm of myth into reality.

Sasakawa-Global 2000 (SG 2000) works primarily in the field, in close cooperation with the governments, to transfer to small farmers the modern agricultural techniques that are the fruit of many years of research work. Spearheading these efforts are the national agricultural extension services with which SG 2000 works closely.

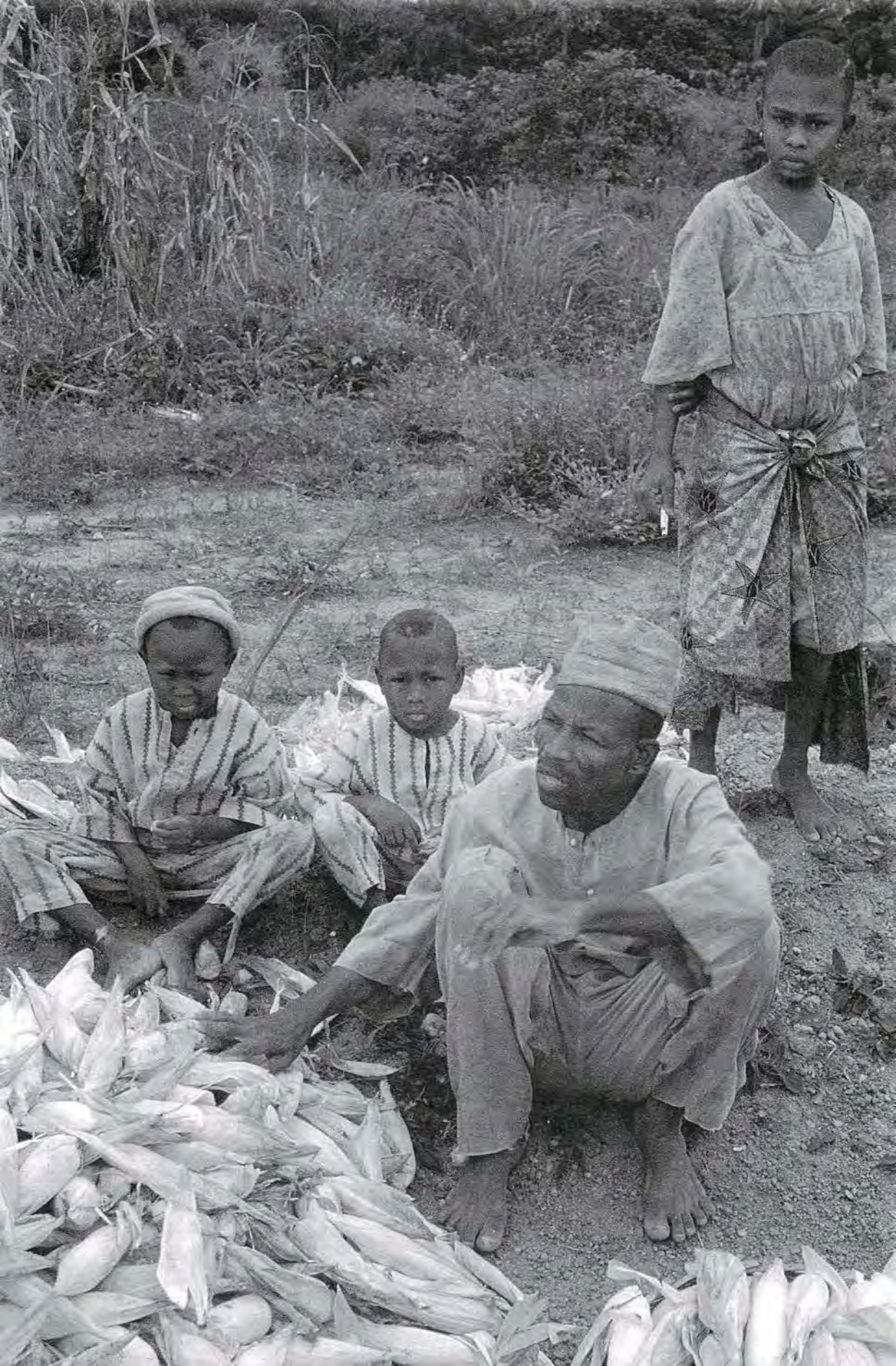
The transfer of technology in itself poses no unsurmountable problems. The small farmer is quick to grasp the usefulness of the technology being demonstrated. The challenge lies elsewhere: whether or not a farmer will make long-term use of a technology that has proved valuable depends to a considerable extent on conditions that generally are incumbent upon the governments to create. Too often, such conditions are still lacking to encourage adoption.

This workshop — held for the first time in a French-speaking country — pursued a dialogue harking back to 1985, between specialists in agriculture and African governments to define a framework for implementing institutional cooperation.

A prime concern of the participants in Cotonou was to reflect on the manner of institutionalizing the indispensable contribution of the agriculture extension services. How also to make sure that the required inputs — fertilizer and seeds — would continue to be available. Other questions were discussed: how can the small farmer be integrated into the marketing circuit, to sell his or her product? How can the development of rural infrastructures, roads, and electricity be accelerated? How can the resources and talent of private agribusinesses be best mobilized to accelerate rural development?

These and other themes were subject of the three-day dialogue. The next pages present these topics to a wide audience, particularly to people who are working to modernize agriculture in Africa.

For the success of this meeting, we must thank many people who worked behind the scenes, often for months in advance, for making the Cotonou Workshop a milestone on the long road that lies before us. Allow me to thank all those Beninois who, at every level of the government, provided support and understanding to our staff. I thank also the staff of the International Institute of Tropical Agriculture in Calavi near Cotonou for their help and kindness; Chris Dowswell for setting up the program; the SG 2000 team in Cotonou for its untiring collaboration; Mrs. Gertrude Monnet and Mrs. Chantal Amegan and the staff of the Prompt Agency; and Messrs. Brook Boyer and Patrick Orr.



Workshop Summary

Wayne E. Swegle and Christopher R. Dowswell*

The Workshop agenda explored a range of topics to strengthen institutional cooperation for the development of African agriculture.

Speakers and participants examined the activities of the Sasakawa Global 2000 (SG 2000) agricultural projects in Benin, Togo, Tanzania, and Sudan.

They examined the case for expanding small-scale irrigation to increase agricultural production as well as development of other rural infrastructure factors, such as roads, power, and water.

They considered development alternatives for achieving efficient and effective organizational systems to deliver technical information and fertilizers, improved seeds, and other productivity-enhancing inputs.

Workshop participants also looked at food marketing, distribution, pricing, storage, and other factors on the output side.

A unique Workshop feature was the mix of decision-makers who attended from public and private sector organizations. Privatization in the seed, fertilizer, food, and feed industries, along with broader aspects of the role of agribusiness in national development, were major topics of discussion.

Following are highlights of these discussions. Key conclusions also are reported in the Policy Recommendations section, beginning on page 197.

Agricultural Modernization Strategies in Benin and Togo

Most African countries are going through a period of economic recovery and structural adjustment. A typical example is Benin's economic recovery and structural adjustment program. It aims to deal with the country's balance of payments problem, attain a gross domestic production growth of 4% per year, and increase the private sector's involvement in the economy. It provides an interesting example of a country-level effort to launch a new agricultural strategy.

Structural Adjustment Should Help Benin. Mama Adamou-N'Diaye, the Republic of Benin's Minister for Rural Development, expressed his belief that the economic circumstances of the rural sector will improve if the new national policy reorientation brings more entrepreneurial freedom and encouragement for the private sector, and more support for peasant organizations.

The country's ambitious rural development priorities include: improving the infrastructure; developing produce storage facilities in the villages; adapting appropriate agricultural technology; promoting exports of products in which Benin enjoys a comparative advantage; developing community-based forestry practices; promoting sounder environmental management; developing pastoral water supplies and increasing emphasis on animal

* Consultant and SAA Director for Program Coordination, respectively.

husbandry; upgrading fisheries' productivity; and integrating rural women and youth into the socioeconomic fabric of agriculture.

For Benin to be self-reliant in food production and have a surplus to sell, agricultural yields and productivity will have to be improved. Adamou-N'Diaye believes that the technology packages recommended by the SG 2000 project have had a positive impact on farmers who see their maize crop yields, for example, double, triple, and even quadruple.

Togo Faces Population Challenges. Togo illustrates the population growth problem experienced by many African countries. With its population of 3.7 million, growing at an annual rate of about 3%, it can expect to have about 5 million mouths to feed by the year 2000.

Faced with this challenge, the Government of Togo is emphasizing growth in its agricultural sector by creating a stimulating economic environment for its farmers. It aims to achieve these ends by: improving the dissemination of improved know-how; settling land ownership claims; providing adequate services to farmers; promoting rural credit; strengthening its research institutions; and improving its infrastructure.

Nicolas K. Nomédji, Togo's Minister for Rural Development, told workshop participants that "women are among the agents of our development, whose ardor at work and determination in the struggle against hunger deserve the attention they have been given in Togolese politics."

He said the country's new strategy for rural development aims to help women by strengthening their organizational development; improving techniques for processing and storing farm products; including them in land reform and redistribution programs; training them to improve their agricultural productivity; and creating women's sections in development programs and projects.

On the structural adjustment side, Nomédji said his government's program negotiated with the World Bank and the International Monetary Fund calls for continuing two types of earlier measures. The first involves helping farmers to develop their own organizations to strengthen agricultural production and marketing activities. The second measure aims to improve the agricultural services offered to farmers. The national extension service is targeting groups of producers who are receptive to innovation and who can influence other farmers.

SG 2000 Works in Benin and Togo. Turning more specifically to SG 2000 activities in the two countries, Marcel Galiba, Country Director for Benin and Togo, said the project aims to help small-scale farmers to increase productivity and income by giving them sound agricultural technology that fits their needs and is sustainable.

Benin and Togo are geographically close, share similar agroecological zones, and have the same cropping patterns with maize, sorghum, and millet, which are the mainstay cereals. SG 2000 established a field testing program for improved technology in Benin during 1989 and in Togo during 1990.

The project has established strong relationships with the Ministry of Rural Development and with the Departments of Extension and Farmers Organization in each country. The activities of SG 2000 are part of the overall agricultural program of the country. Staff of the Ministry involved in the project in each country may participate on a part- or full-time basis. Logistics and allowances are provided to the collaborating staff.

Technology Recommendations are Research-Based. The improved technologies being recommended in the SG 2000 field program are based on national and international research. Components include row planting, improved varieties, moderate application of chemical fertilizers, timely agronomic practices, and effective postharvest practices. These technologies can double or triple yields without endangering the natural and human resource base in Benin and Togo. Maize and sorghum were the initial target crops because of their importance in both countries.

To combat land degradation and restore soil fertility, the project is promoting the use of velvet bean (*Mucuna utilis*) as a green-manure cover crop. Not only does this grain legume add nitrogen to the soil and help to build up organic matter, it also smothers speargrass (*Imperata cilindrica*), a weed plaguing many farmlands in southern Benin and Togo.

President Soglo Calls for Increasing Production. Benin President Nicéphore Dieudonné Soglo emphasized the importance of new technology to his country in his opening remarks: "Today we must prepare the future and secure lasting food security for our population by considerably increasing production in the traditional patterns that underlie our nutritional habits.

"In this perspective, the importance of the Sasakawa Global 2000 project needs no demonstration for it is general knowledge that the African farmer is no longer satisfied with eking out a pitiful yield from a few acres of mediocre and fragile soil. Faced with growing population pressures and ever-shorter fallow periods, it is imperative that African agriculture be guided towards new methods of cultivation that skillfully integrate the improvements of modern technology with traditional practices in the field."

President Soglo continued, "The promotion of modern technologies constitutes, in our opinion, is the foundation upon which to build the rural world of tomorrow, where men and women will have a greater say in their own future, based on know-how that is appropriate to their region." He observed that if agriculture is to succeed, the political influence of farmers will have to match their economic importance.

Reviewing The SG 2000 Project in Tanzania

A mid-term review of the Kilimo-Sasakawa-Global 2000 project in Tanzania was carried out in June 1992 by a team comprised of Francis Idachaba, John Coulter, and Uma Lele. Professor Eija Pehu, representing the Finnish Government's FINNIDA, and Bekki Johnson, of the Carter Center, served as resource persons.

The SG 2000 project in Tanzania was started in 1989 and had an operating budget of about US$ 1 million per year in 1992-93. The SG 2000 project collaborates closely with the Ministry of Agriculture, Livestock Development and Cooperatives, commonly known as "Kilimo," the Swahili word for agriculture.

As is the case in other project countries, the project's major objective is to introduce modern agriculture to cereal growers through the use of fertilizers, improved varieties, and improved agronomic practices. It assumes that the green revolution approach, so successful in Asia, can be adapted to African conditions. Tanzania provides more challenges than did India and Pakistan, which had abundant trained manpower and a political commitment to develop smallholder agriculture. In addition, the transport and communications networks were good in India and Pakistan, whereas they are weak in Tanzania. However, Tanzania has undertaken major policy

reforms since 1986. The review team pointed out that projects such as SG 2000 can make these reforms more effective and have a greater impact.

The Ministry's regional and district officers help select locations of field sites and farmers within villages. They supervise field staff who are involved in project activities. After the extension workers from the selected villages are trained, 10 farmers from each village are chosen to participate in the first year of the project. More farmers are added in the second and third years so that, by the time the village graduates (completes its participation in the project), 50 or more farmers may have taken part in MTP program.

In Tanzania, as in other SG 2000 countries, the farmer-managed management training plot (MTP) is quite large, covering one acre (0.4 ha), in contrast to most demonstration plots which are usually 1/20 acre or less. The large plots offer several advantages over the smaller conventional demonstration trials. For example, they let farmers realistically assess the labor needed for the improved technology and they emphasize the need to apply the right inputs at the right time. Therefore, they show not only farmers, but policy-makers, administrators, and private sector suppliers the potential and the needs of improved technology.

SG 2000 Increased Yields in Tanzania. The Tanzania SG 2000 review team found that in 1990-91, about 8,900 maize MTPs were planted in 280 villages in six regions and about 650 sorghum MTPs also were planted. The MTPs showed that maize yields could be increased from the traditional average of about 1.5 t/ha to more than 4 t/ha, with some farmers reaching 8-9 t/ha.

The review mission visited many villages and noted the uniformity of the maize crop and the high yields of the MTPs. Nutrient deficiency symptoms in nearby fields — where traditional practices were used — confirmed the generally low fertility of the soils. These visits also confirmed the high quality of the agronomy in the MTPs and the farmers' enthusiasm for the program. For example, farmers said the new technology increased their purchasing power and helped provide for their children's education. The mission found strong political support for the program.

Village-level extension workers are strongly motivated by having something tangible to offer farmers, by having transport available, and by recognizing their important role in improving agriculture. Loan repayments in the first 2 years of the project were good, except where drought intervened. The mission found that the project avoided some of the problems that occurred elsewhere by not expanding too quickly and by limiting the MTP's to a manageable number.

Regarding the criticism that the new technology relies on introduction of chemical fertilizer, the mission found that traditional farming systems — which essentially mine the soil of its nutrients — are not sustainable in the long term. Fertilizers offer long-term benefits in building soil fertility to counteract the soil nutrient mining that is taking place under the present farming systems.

Improving the fertility of the soils benefits all crops, whether they are grown for sale, for household use, or as part of a mixed-crop system. The residual effects of improving soil fertility allow farmers to diversify their cropping systems and to develop new and more-profitable crop combinations.

The cost of fertilizers is, obviously, a serious issue. The mission noted that farm productivity is highly sensitive to yields and to input and output prices. Small and large farmers indicated that their inability to buy the right inputs at the right time was a major

constraint. The MTP farmers expressed serious concern about the supply of inputs when SG 2000 withdraws.

Mission members believe that the fertilizer/improved seeds technology must play an increasingly important role in improving agricultural output in Tanzania. In the absence of such inputs, soil conditions will continue to deteriorate, pressures on forest lands and on fragile areas used for grazing will increase, and labor productivity will fall.

The mission recognized that a blanket fertilizer recommendation was needed to start off the program. However, in the future, fertilizer recommendations need to be refined for different farming systems and for farmers with differing levels of resources so they will be more efficient and cost-effective. They need to take account of the farming system, the previous crop, the soil type, phosphorous status, and the risks due to erratic rainfall.

The project's success has stimulated farmers to request that it be extended to other crops (beans), other commodities (fuelwood), and other factors, (animal traction). The project's limited financial and management staff resources means that SG 2000 must consider any expansion carefully, particularly as it is already moving into the post-harvest and animal-traction fields.

The Project Supports Tanzanian Policy. Jackson Makweta, Minister for Agriculture of Tanzania, discussed the SG 2000 contributions from the country's standpoint. He said that attaining national food self-sufficiency and, subsequently, producing surpluses for export, is the centerpiece of Tanzania's agricultural development policy. "Therefore, we appreciate the efforts of SG 2000 to support small-scale farmers by introducing appropriate technologies to increase their farm productivity.

"Our experience with the SG 2000 agricultural project has helped us to realize a significant part of our aspiration of increasing food production. It also has demonstrated successfully the potential contribution of small-scale producers and stockists as private entrepreneurs in a more-developed agricultural production system. These initial results have heightened our expectations for realizing our agricultural development aspirations."

Makweta said the SG 2000 project strengthened Tanzania's agriculture and institutions in the following ways:

- It strengthened the extension service's capability to disseminate information and increased the effective coordination between research and extension in delivering new technology to small-scale farmers.

- It demonstrated ways to increase small-scale farmers' productivity and raised their expectations of how much their farming systems can produce.

- It enhanced market demand for the components of improved agriculture, thereby stimulating the growth of an increasingly privatized input-delivery and marketing system at the village level.

Recent SG 2000 Project Developments. Michael Foster, Acting SG 2000 Country Director for Tanzania, elaborated on several new project activities. One has been the addition of an extension program in 1993 to promote more widespread and effective use of oxen for plowing and cultivating, and for transportation. Working with the Ministry, numerous animal-traction training sites have been established in villages and equipped with improved animal-drawn implements (plows, cultivators, carts). Training of oxen

and of operators to use these improved implements to best advantage is under way.

A postharvest program also was introduced in 1992 to increase the farm family's food security. A survey identified the most important causes of losses in grain quantity and quality. The package of practices that was developed to alleviate those problems includes improved grain handling and storage equipment. A in-service training program was established to train extension workers in the recommended postharvest technology.

Intensifying Production on Favored Lands

Musa Mohamed Musa, First Undersecretary for Agriculture in Sudan's Ministry of Agriculture, Natural and Animal Resources, discussed Sudan's strategic policy priorities in agriculture, which include using available irrigation to the maximum; attaining sustainable growth in traditional rainfed crops; developing the rural infrastructure; and promoting adaptive research, packages of technology, and extension.

Musa said that projects such as SG 2000 have helped farmers to test available technologies for important crops. The SG 2000 methodology could be used with other suitable crops when the extension service is in place.

Increasing productivity of sorghum and wheat under irrigation is important to Sudan in light of rising costs of production and competition for resources. Evidence of much-increased yields is coming from the national program in areas reached by SG 2000 in the Gezira Blue Nile and White Nile irrigation schemes.

Irrigating Wheat vs. Cotton Was Studied. Rashid Hassan, an Associate Economist with CIMMYT, stationed in Kenya, reported on the comparative advantage of wheat and cotton in using Gezira irrigation water under widely varying conditions, prices, and other factors.

The study is relevant because the proportion of irrigated land devoted to food production has steadily increased in Sudan over the past two decades. The country's severe food shortages after the 3 years of drought in the early 1980's, reduced availability of wheat aid, and encouraging results of on-farm tests of improved wheat production practices caused Sudan to strive towards self-sufficiency in food, particularly wheat.

Before more land and water are switched from cotton to wheat, the gap between potential and farmer's wheat yields needs to be closed so as to make wheat farming efficient. Sensitivity analysis showed that Gezira tenants who currently produce wheat by traditional methods would have to raise their yield levels by more than 34% — from 1.4 t/ha to 1.9 t/ha — to compete with cotton at 1993 price levels. The findings indicated that Sudan's policy-makers need to

- remove the obstacles to higher and faster adoption of improved wheat production technologies
- liberalize input procurement and delivery systems for more efficient and timely utilization of modern inputs
- allocate land and other resources among competing crops within the public irrigation schemes more flexibly so domestic resources can respond to changing international economic opportunities

Small-scale Irrigation Is Growing. Small-scale irrigation is important in intensifying production in favored lands of sub-Saharan Africa.

Alhaji Wada Dederi, Managing Director of the Kano State Agricultural and Rural Development Authority (KNARDA) in Nigeria, said the northern states of the country have a combined potential for small-scale irrigation of 3 million hectares, according to 1992 World Bank estimates. There is a compelling need to develop irrigation schemes in that part of the country. The climate is semiarid, vegetation typically is savanna, rainfed production is less than 4 months, and average annual rainfall ranges from 450 to 500 mm. These unfavorable climatic conditions usually lead to low yields of rainfed crops and drought usually occurs every 3 to 4 years.

Small-scale irrigation can mitigate the effects of drought. Further, with small irrigation, smallholders grow a minimum of two crops per year. And modern irrigation methods increase the area that a farmer can irrigate. As of 1985, about 20,000 hectares of northern Nigeria were being irrigated by traditional techniques. With the introduction of new methods under the Agriculture Development Authorities, the irrigated area rose to 179,020 hectares by 1992.

KNARDA, established in 1982, is charged with increasing food production on about 900,000 ha cultivated by 430,000 farm families. Because most of the farmers are subsistence smallholders, the state government looks to developing small-scale irrigation as a way to provide jobs for the teeming rural populace. Achieving this goal will be furthered by a National Fadamas Development Project supported by the World Bank, which will pay particular attention to environmental sustainability of the fadamas irrigation system (riverain areas) as related to other claims on land and water resources.

KNARDA began collaborating with SG 2000 in mid-1992. The agreement calls for Kano State to provide office accommodation for the project coordinator and some frontline extension agents to help implement the program. The SG 2000 project chose wheat for demonstration during the dry season (under irrigation) and maize and cowpea during the wet season. During the 1992-93 dry season, the SG 2000 project involved 160 small-scale farmers. Fresh pure seed of high-yielding wheat varieties originally developed by CIMMYT in Mexico is being multiplied at the Kadawa seed multiplication farm for more extensive distribution to farmers during the 1993-94 season.

This first cycle of field demonstration plots provided the SG 2000 team with insights on ways to demonstrate its recommendations under local conditions. It uncovered production problems to be overcome, including late land preparation, lack of timely input supply, and farmers' idiosyncrasies in accepting new technologies.

Although the SG 2000 wheat demonstration program is in its first year, many farmers in the Kano River Project area already are aware of it. Dederi said, "I am convinced that, with SG 2000 experience and expertise in wheat production — particularly considering the resounding success achieved in Sudan — Kano State farmers could obtain yields of 3 to 5 t/ha. This would bring dramatic wheat production increases since the present average yields obtained by farmers are below 2 tons per hectare."

Strengthening Technology Delivery Institutions

Describing SG 2000's efforts to strengthen institutions concerned with technology delivery, Chris Dowswell, SAA Director for Program Coordination, said SG 2000 scientists and managers believe that if farmers are to feed their nations modern research information and higher input levels

must be used on Africa's best lands and that agricultural intensity should be reduced in the more-fragile ecologies.

"We reject the contention of some agriculturists that small-scale food producers can increase their productivity and be lifted out of poverty without the use of appropriate purchased inputs, such as improved seed, fertilizer, and crop-protection chemicals."

Although small-scale farmers generally are aware of improved seed, fertilizers, and so forth, they often lack the detailed knowledge they need to take full advantage of these inputs. Therefore it is important to strengthen agricultural extension to carry that information to farmers. SG 2000 is involved in several ways.

SG 2000 devotes a quarter of its country project resources to training-related activities. SG 2000 projects gives frontline extension workers in-service training, which follows the growing cycle of each crop. Extension workers, in turn, train participating farmers — as well as their neighbors — through organized groups, using the plots in the vicinity as teaching sites. Frontline extension officers involved with the SG 2000 projects see to it that Production Test Plot (PTP) inputs are delivered to participating farmers on time, handle credit arrangements, and recover the loan value of the inputs after harvest.

Dowswell pointed out that, in asking extension workers to be responsible for input delivery and loan repayment, "we are not advocating that extension officers become commercial input distributors nor money lenders. Rather, we justify their help in supplying inputs to PTP cooperators on two training grounds:

- "We want the farmer to use the full package as recommended, especially since the timing of operations is critical to getting the most benefit from the new technology.

- "In being responsible for repayment of the input loans to PTP farmers, the extension workers assume some of the risk associated with the recommended technology."

Beyond the SG 2000 emphasis on training extensionists and broadening their experiences in its country projects, SAA is strengthening the skills of extension staffs through fellowships. This initiative is based on the following facts.

- Many of the environmentally friendly technologies being developed by agricultural scientists today are knowledge-intensive. Transferring these technologies and getting them adopted will be more effective if agricultural extension programs are strengthened and rural education systems are improved.

- Unless the technical competence of frontline extension staff in sub-Saharan Africa is vastly improved, spreading such modern practices as integrated pest management and use of crop rotations, organic manures, and residues to maintain soil fertility are unlikely.

In light of these facts, the SAA board of directors in late 1991 approved a new program that provides fellowships for extension supervisory and frontline technical staff to pursue formal university degree training, primarily at African universities, and supports the upgrading of the quality of university training in agricultural extension.

This extension-strengthening initiative is called the Sasakawa African Fellowship and

Extension Education Enhancement (SAFE) project. By the end of 1993, SAA, through its SAFE project, will have awarded some 15 BSc and MSc fellowships for study at African universities and three PhD fellowships to study overseas.

In addition, SAFE is providing financial assistance and other resources to several universities to strengthen their agricultural extension curricula and field practicum programs. It is working with the University of Cape Coast in Ghana, which recently established a new BSc program for mid-career extension staff with either certificate or diploma credentials. The new curriculum was developed in consultation with extension leaders, seed producers, and farmers. It is practical and well-suited to upgrade the skills of these mid-career professionals. The first class of 23 extensionists began their studies in the Fall of 1993.

SAFE also is assisting the University of Ghana, Sokoine Agricultural University in Tanzania, and the University of Benin in Cotonou, to upgrade their curricula and renew their library collections on technology transfer methods. In the future, SAA expects to lend its support to other agricultural universities in SG 2000 project countries.

Other Technology Delivery Systems Work. Nongovernmental organizations (NGOs) are taking other approaches to institutionalizing technology delivery systems. An example is illustrated by the collaboration between Winrock International Institute for Agricultural Development, the US Peace Corps, and several other NGOs in helping smallholder farmers in some countries of sub-Saharan Africa to obtain, produce, store, and plant improved seeds.

Pierre Antoine, Winrock's Africa and Middle East Director, described the On-Farm Productivity Enhancement Program (OFPEP) operating in several West African countries. OFPEP increases small farmers' access to good seeds and helps them understand how to conserve and build soil fertility through practices that require few external inputs. It has some attributes that are similar to SG 2000.

OFPEP program staff identify local organizations involved in agricultural activities that could benefit from their assistance; discuss traditional seed production and soil management systems with local farmers and extension agents; develop technical training programs for NGOs, Peace Corps, and extension staffs; conduct demonstrations with farmers; review results and farmers' reactions to the demonstrations; and modify their activities accordingly.

OFPEP remains flexible to be able to replicate activities from region to region or from partner to partner. It adapts its services to regional needs or the mandate of each partner organization. Each NGO has unique needs and a specific focus. For some, emphasis is on soil management; for others, on seed production or storage; for still others, on agronomic practices.

Reaching Women Farmers Is Crucial. The institutional challenges in reaching women farmers with improved technology were discussed at length in the workshop. Joyce Endeley, Senior Lecturer at the University of Dschang, Cameroon, presented a paper on the subject.

"In Africa, women's farming systems are still characterized by hoe culture, low use of improved inputs such as fertilizer and new seed varieties, indigenous practices, inadequate access to extension services and other agricultural institutions, and low productivity," she said in introducing her topic. She pointed out that women farmers

constitute more than half the agricultural labor force in many African countries. They are dominant actors in the traditional food sector and they are vital to alleviating food insecurity.

Endeley called for real commitment to get action-oriented programs for women farmers implemented in order to reach them with improved and appropriate technology. She pointed out that diffusion of technical knowledge — coupled with inputs such as fertilizer, improved seeds, credit, and better farm tools — can significantly increase women farmers' productivity and household income.

Poor women farmers face more constraints than poor men farmers in gaining access to institutional services for various reasons. Socio-cultural practices restrict women from owning land title — which is sometimes used as collateral for loans and inputs — and government policies favor traditional export crops (mostly produced by men) over staple food crops (grown mostly by women).

There are gender differences in tasks performed in crop and livestock production, allocation and use of household resources, and distribution of benefits from economic activity. These differences need to be recognized by research, extension, credit, and other agricultural organizations in planning programs to serve women farmers, Endeley said.

Fertilizer and Seed Industry Development Prospects

Agriculture is a top priority of most African countries. Even though this common thrust toward agricultural development has many similarities, the laws of each African country are tailored to meet its unique political, economic, and cultural conditions. Private industry must understand the particular environment in which it chooses to invest. Private companies will encounter many issues, barriers, and problems that will require both individual and collective solutions.

Edward Shonsey, Senior Vice President of Pioneer Hi-Bred International, USA, called for collaboration between the public and private sectors in building a private seed industry. The seed industry's magic is that it can speed the economic progress of developing countries while drawing on the greatest strengths, experience, and resources of both the public and private sectors, he said.

The private seed sector needs to address a wide array of issues and considerations — including agronomic, political, economic, product, market, program, and people — in order to succeed. In particular, the following imperatives need to be addressed:

- The market potential must be large enough.
- The country must want to have the business and its people there and it must recognize the need to privatize the seed sector.
- Good managers, hard currency, and financial, human, and physical resources must be available.
- Plant breeders' rights need to be recognized, government rules and policies need to be equitable, limitations on importing and exporting seeds need to be realistic, and seed legislation and rules must be clear and reasonable.
- There must be sufficient infrastructure (such as roads, railways, and storage facilities) to support a seed industry.

Shonsey said, "Government should support the private seed sector and the private seed sector should, in turn, respect the government's challenges. I find the best, and

perhaps the only, solution to these differing interests is an ongoing dialogue between the different sectors."

Fertilizer Sector Development Is a Priority. As mentioned frequently in this Proceedings, fertilizer is a critical input and its timely availability is critical. H.J.M. Wientjes, Managing Director of WIENCO Fertilizer Co., Ghana, pointed out that the elimination of fertilizer subsidies in Ghana has made fertilizer use unprofitable (or only marginally profitable) for basic foods. He proposed ideas to help private sector importers and distributors lower the cost of fertilizers to farmers.

One idea he advanced called for a 20% levy on imported maize, wheat, sugar, and rice to create a fund for subsidizing fertilizer prices. The fertilizer subsidy would benefit local farmers because it would help lower the cost of producing his/her farm products.

Other measures to lower farmgate costs include preferential access by fertilizer importers to foreign exchange and credit lines, reduced interest rates through fertilizer bonds, various forms of rebates to reduce port charges and transport costs, and financial mechanisms to protect importers against the risk of local currency devaluations.

Rural Infrastructure: Roads, Power, Water

The availability, cost, and reliability of road transport services is of considerable concern to agricultural producers and policy makers. Problems of getting inputs to the village and the farmer and moving produce from the farm to market constrain the development of African agriculture. With the globalization of agriculture and commerce, the infrastructure serving rural areas becomes even more important.

Jean Doyen, Chief of the Environmental and Sustainable Development Division of the World Bank's Africa Region Technical Department, cited a survey conducted by a French transport research institute of four West African countries showing that trucking costs are well above those in other developing countries. They are as much as five times higher than in Pakistan.

Doyen outlined a litany of problems, such as: the poor condition of roads; low demand; poor market organization; high cost of vehicle parts; difficulties in obtaining credit; road accidents; and roadside inspections by numerous administrative bodies that cause delays and charges.

The trucking industry in sub-Saharan Africa is remarkably resourceful and resilient even though it is not very efficient. Trucking operations, which often are small semi-formal enterprises, are subjected to numerous regulations but, in practice, entry and operations are relatively free.

Government attempts to organize and allocate cargo through freight bureaus have not served shippers well. The recent reform of Chad's freight bureau — limiting its role to monitoring — was followed by a substantial (more than 20%) reduction in rates. Use of parastatal truck fleets generally has been inefficient and has stifled the industry's development.

Shippers, along with other relevant agencies and groups, need to participate in policy discussions and support an enabling and competitive environment for trucking. Doyen contended that agricultural producers should support reliable funding for road maintenance and accept adequate and effective taxation of road users to pay for them.

Doyen also confirmed that the competitiveness of sub-Saharan Africa's products is undermined by the high cost and low quality of overseas and regional transit. It is overburdened by documentation requirements, restrictive regulations, and para-fiscal fees and charges. A comparison of maritime transport costs — supported by consultations with shippers — shows that current cargo allocation practices of several West and Central African countries hamper shippers' access to the services they consider best adapted to their needs and least expensive. These practices have kept Africa lagging behind the rapid evolution of worldwide maritime transport and logistics.

Electricity is Needed for Development. Electric power is another important component of the rural infrastructure and one that presents a challenge in sub-Saharan Africa. An adequate supply of electricity is a prerequisite for economic development. In Africa, where two-thirds of the rural people live in widely scattered villages or centers of a few dozen or a few thousand inhabitants, increasing the supply of energy for rural development is important for socioeconomic progress and it is difficult. It also is important in maintaining a country's natural resources. Using firewood and other types of biomass for fuel depletes natural resources and harms the environment.

Désiré Chokki, Sectoral Economist of the African Development Bank (AfDB), Cote d'Ivoire, pointed out that demand for electricity is weak, for it is used primarily for lighting. Household demand alone often is too low to justify the investments required for rural electrification.

On the other hand, rural electrification can improve people's standard of living by providing electricity to rural households, agro-industries, health centers, schools, irrigation pumps, and water-supply stations. It contributes to development, national income, jobs growth, living conditions, and agricultural production.

The modest level of AfDB financing for rural electrification does not reflect any specific orientation of the Bank's investment policies. It stems from the absence, in most African countries, of a clear-cut and sustained rural electrification strategy.

Tunisia is an exception to the rule. Chokki said that AfDB has continuously invested in rural electrification in Tunisia since 1977. The country has built three of the 12 projects funded by AfDB and received about 40% of the loans made by the Bank. The country's social and capital investment policies are clearly defined and implemented. Rural electrification has remained a priority of the Tunisian government through a succession of national development plans.

Rural electrification projects financed by the AfDB in Tunisia demonstrate that rural electrification can be a profitable venture and bring benefits from the economic, social, and cultural points of view. "Rural electrification remains a field in which government social and rural development strategies can yield high returns," Chokki said.

Water Should be Considered in a New Light. Turning to the important infrastructure factor of water, Guy LeMoigne, Senior Advisor in the World Bank's Agricultural and Natural Resources Development Department, noted that most developing countries have concentrated their rural water investments in irrigation and drainage. This is partly because food self-sufficiency has been one of their major goals. Yet there is intense competition for water, both within agriculture — between farming

and livestock, for example — and between agriculture and other sectors of the economy, such as power supply and industry.

Policy-makers need to look at water problems and opportunities in a new light, considering changing conditions. Water is inherently scarce and its supply is highly variable in sub-Saharan Africa. The costs of producing new water supplies are mounting rapidly and growth in demand continues to be strong. Water's inherent scarcity and increasing cost is prompting much greater efforts to improve irrigation technology, price water correctly, and manage it efficiently, which usually means through private water-user associations.

On the whole, small-scale private irrigation schemes have performed favorably. Farmers and small investors have increasingly engaged in small-scale private irrigation on a self-sustaining, cost-effective basis, with little or no assistance from governments or aid agencies. In fact, over the past 5 years, the main growth in irrigation has occurred in modern small-scale irrigation, with little or no state support, LeMoigne said. Large irrigation schemes developed and maintained by governments — often with large external financial or technical assistance — have generally lost favor.

Another new factor for policy-makers to consider is the increasing competition for water between countries. River or drainage basins that are the sources of water do not respect country borders. It is crucial for countries to work together, not simply to avoid conflicts over water resources, but to develop and manage river basins to their mutual benefit.

LeMoigne pointed out that policy-makers also need to embrace the concept of involving the people who have an interest in water policy — the stakeholders — in formulating strategies that affect them. The concept of local people having a sense of ownership of the infrastructure and policies of projects speaks directly to the subject of this workshop; capacity-building and stakeholder participation are truly two new initiatives for cooperation among international institutions, governments, and domestic groups and individuals, he said.

Integrating Smallholders into Commercial Agriculture

Workshop speakers and participants examined the marketing side of the agricultural sector, with particular attention to smallholders and prospects and prerequisites for developing the private sector food and feed industry. One key to developing markets is to get agricultural development policies right.

Joseph B. Wanjui, Development Director of the Unilever Plc., Middle East and Africa Division, and based in Kenya, said, "African farmers respond rapidly to the right policy climate. The conventional wisdom that they are inefficient, tradition-bound, and averse to innovation could not be further from the truth. They are extremely adaptable and manage efficiently, given their difficult environment and limited knowledge and resources."

He suggested, "We can learn from what Kenya has done wrong," explaining that, until the end of 1970s, Kenya's economic performance was hailed as an example that other African countries should follow. Her high economic growth rates were fueled by the dynamic performance of both the private manufacturing and agriculture sectors. However, in the 1980s, the country began to decline economically as government increasingly interfered in the marketing and distributing of agricultural produce.

Wanjui called attention to the country's livestock sector potential. It produces about 7% of gross domestic product and could generate considerable off-farm employment in marketing and processing related inputs and outputs. It also has a high potential to earn foreign exchange, especially through export of beef and pork products, live animals, and hides.

An important determinant of future growth in the livestock sector is the availability of high-quality feeds. Raw materials such as maize are rationed as the first priority is to feed people. In some countries, it is a crime to transport maize from certain districts without a government permit. The price of maize is controlled. All cereals are distributed by a government parastatal. Government interference also has affected the growth of alternative sources of oil cakes.

Wanjui cited a 1982 FAO study of the carrying capacity of the continent's land resources that showed Africa's cultivatable land could produce enough food to feed 1 billion people — even at the low input levels prevailing in most of the countries. With improved methods, the land could produce enough food for 4 billion people. Zaire alone, for another example, could feed the entire population of Africa using improved, western-level methods and inputs.

"With decontrol of agricultural production, processing, and marketing, a greater role for the private sector, improved incentives for farmers, and a stable political environment, there is no reason why African agriculture cannot rise from the depths it currently occupies," Wanjui said.

Small Farmers Can Operate Rural Agribusinesses. Edward Bullard, President of TechnoServe, Inc., USA, discussed the challenge of integrating small-scale farmers into commercial agricultural marketing systems. "TechnoServe's experience demonstrates that profitable and sustainable rural agribusinesses can be established and operated by rural small farmers and that helping to create them can be cost-effective.

"We also have learned that there is no quick and easy path to success. The process requires a long-term commitment by the implementing agency, a professional approach, adequate funding resources, and an economic and political environment that is conducive to enterprise development."

Bullard told workshop participants of two important lessons his organization has learned. We realized that if we wanted to reach rural small farmers, we could not rely on individual entrepreneurs, he said. The enterprise needs some type of group structure that allows the cost of assistance and the rewards to be spread over a larger population.

"This led to our belief that we needed to target medium-scale enterprises, which attract the interest and commitment of rural farmers and offer the prospect of competing in the modern money economies developing in Africa."

Further, he said, TechnoServe has found that the most important factors essential to developing enterprises include: choosing countries with favorable economic environments, targeting specific commodity sectors, and ensuring that beneficiaries have a financial stake in the enterprise.

Targeting Emergent Commercial Farmers. Mandivamba Rukuni, Professor of Agricultural Economics and Extension at the University of Zimbabwe, reviewed his country's agricultural history. Over the past century, Zimbabwe has experienced two agricultural revolutions.

Rukuni believes that "There now is a need for agricultural policy-makers and planners in Zimbabwe to move beyond structural adjustment and develop a strategy for a third agricultural revolution. Institutional and policy reforms should be aimed at...the 700,000 smallholders and the tens of thousands of micro-enterprises that are scattered across Zimbabwe's rural landscape."

He listed four interlocking elements of the new revolution: The first is to expand food production in favored areas, especially maize, because it accounts for about half the calories in the average diet in Zimbabwe. Research priorities over the next 10 to 15 years, should be to breed maize, sorghum, and millet varieties and to develop crop management practices that smallholders in resource-poor areas can use. Related, Zimbabwe's road and transport system must be improved and fertilizer distribution must be strengthened.

The second element consists of policies, programs, and support services to expand the production of traditional exports such as cotton and tobacco. These generate rural employment, government revenues, and foreign exchange earnings.

The third element is expanding nontraditional exports such as cut flowers, horticultural products, ostrich hides and meat, and crocodile products. The strategy recognizes that the export market for horticultural products and cut flowers will be intensely competitive in the 1990s.

The fourth element is expanding rural nonfarm activities, such as small-scale industry, trading, and microenterprises. Rural households without adequate land or resources must be assisted by special food-for-work programs and food safety nets, plus investments in health and education to equip them to eventually migrate to the industrial-urban sectors.

Welcoming Address: Africa's Agricultural Development Imperatives

Nicéphore Dieudonné Soglo
President of the Republic of Benin

Dear President Carter, Dear Mr. Sasakawa, president of the Sasakawa Foundation, dear Dr. Norman Borlaug, Nobel Peace laureate of 1970, honorable guests, ladies and gentlemen. Benin is honored to host today, within the context of the activities of the Sasakawa Foundation, an international meeting on developing African agriculture.

On this happy occasion, I welcome to this land of freedom the eminent representatives of the realms of politics, economics, and science who are with us today and convey to them the joy of the people of Benin at having been chosen to host this important meeting.

This meeting is taking place at a time when the African continent is living through a period of democratization that bears witness, not only to its thirst for freedom, but also to its yearning for greater economic and socio-cultural well-being.

From the days of independence to the present, the rural world has played a primordial role in the economic development of African countries. In Benin, where the rural population accounts for over 70% of the total population, agriculture provides 40% of the gross domestic product and 40% of export income.

Thanks to the financial support of some of our partners in development, cotton, now our main export crop, has enjoyed uninterrupted growth for almost a decade. However, problems in agriculture cannot be solved through the success in cotton production alone. Diversification in agriculture must be achieved through greater support for market produce, which presently is providing high incomes to producers. Food self-sufficiency and its pendant, food security, are essential for any development process to remain free of increasingly expensive food imports or requests for food aid that always fall short of requirements.

Benin has watched its food imports — primarily rice and wheat flour — rise from 8,000 tons to 126,000 tons in 15 years, and food aid from 9,000 tons to 13,000 over the same period. By the year 2025, Benin's population will be 10 million. Today we must prepare the future and secure lasting food security for our population by considerably increasing production in the traditional patterns that underlie our nutritional habits.

In this perspective, the importance of the Sasakawa Global 2000 project needs no demonstration for it is general knowledge that the African farmer is no longer satisfied

with eking out a pitiful yield from a few acres of mediocre and fragile soil. Faced with growing population pressures and ever-shorter fallow periods, it is imperative that African agriculture be guided towards new methods of cultivation that skillfully integrate the improvements of modern technology with traditional practices in the field.

The promotion of modern technologies constitutes, in our opinion, the foundation upon which to build the rural world of tomorrow, where men and women will have a greater say in their own future, based on knowhow that is appropriate to their region.

The theme of this meeting, "Developing African Agriculture: New Initiatives for Institutional Cooperation," is a timely one. It emphasizes once again that the development of the rural world must not become the monopoly of any structure, not even the state. Rather it should remain an ideal, in the pursuit of which the actors of development — be they politicians, scientists, bankers, or technicians — leave all sterile rivalries and paralyzing incomprehension behind in favor of fruitful cooperation.

In this field, the Sasakawa Foundation is a living example of harmonious cooperation between different structures all over the world.

I am delighted that the broad objectives of the foundation, and particularly of the Global 2000 project, are perfectly suited to the general orientations defined by our reform-minded government in order to revive our national economy.

My government, indeed, has decided to grant a privileged position to the rural world, the salient representatives of which receive particular attention on a yearly basis. Model farmers are rewarded every year for their contribution on the development front. The Farmers' Celebration, as it is known, is our way of restoring the rural world to its rightful place so it may contribute more significantly to the evolution of our young nation.

Your excellencies, ladies and gentlemen, allow me to pay deserved tribute to the pillars of the Sasakawa Global 2000 Agricultural Project, Mr. Ryoichi Sasakawa, Mr. Jimmy Carter, and Dr. Norman Borlaug. Despite their experience, they still place their trust in Africa and stand by our side as we face the challenges that assail us when they could have stayed home, enjoying the peace of their golden years of retirement.

President Jimmy Carter honored us tremendously by visiting us last year; this demonstrates his keen interest in cooperation with Africa and particularly Benin.

Mr. President, during your years as the leader of the United States of America, you maintained cordial and fruitful relations with the poor countries. My country remembers the high points of Benin-USA cooperation, for which you provided dynamic impulsion by giving your personal support to our programs of action against poverty and disease. Kindly accept our thanks for the work initiated at that time, and which you continue to pursue today for the greater good of all of Africa.

As for you, your excellency Mr. Ryoichi Sasakawa, in letting your heart speak through the foundation that bears your name, you have set a fine example for the wealthy of this world. You firmly believe that all men on earth are brothers and that fortune has no meaning unless it helps the poor and disadvantaged to overcome their

difficulties. To attain this humanitarian ideal, you have committed yourself to helping the poor countries put an end to famine, malnutrition, and disease. Allow me to convey the thanks of the people of Benin to you.

It is a great honor for me as well to have among our distinguished guests Dr. Norman Borlaug, the eminent scientist and agronomist, father of the green revolution in Asia, and Nobel Peace laureate in 1970. Dr. Borlaug is well-known to us in Benin as an untiring defender of the principle of placing science at the service of humanity.

As president of the Sasakawa Africa Association, Dr. Borlaug is at the heart of the Sasakawa Global 2000 project and his efforts have borne tremendous fruit. Indeed, 351 villages in 69 sub-prefectures throughout Benin have been affected by the Sasakawa Global 2000 project. We very much hope that the experiment will continue and be extended to other African countries. We are pleased to offer Benin as a base for this important development activity, which, we hope, will spread throughout Africa and all over the world.

It is also a great honor and a special joy to have with us in this hall another great friend of Benin. I am referring to General Olusegun Obasanjo, former president of the Federal Republic of Nigeria.

As head of the Nigerian state, he made a significant contribution to strengthening the excellent relations that have united our peoples for centuries.

Mr. President, your active contribution to the liberation of Africa and to its economic and social development are highly prized beyond our borders. We remember the eminently positive part you played and continue to play in the various efforts to integrate the West African subregion and Africa in general, by providing support at forums, roundtables, and symposia for promoting the rural world through agricultural development projects.

Rest assured, Mr. President, that you remain an unforgettable friend to the people of Benin, a model and a living example of a return to primary sector activities.

Distinguished guests, ladies and gentlemen, this meeting in Cotonou is being held in the middle of the 1993-94 National Agricultural Campaign. In my address to the rural world on May 6, at the launching of the agricultural campaign, I said, in substance, that our struggle to improve the living conditions in the rural world requires that we have recourse to cultivation techniques that are non-damaging to the environment, control our pastoral systems, and abandon methods of fishing that have disastrous implications for the aquatic fauna; in short, that our producers master every modern technique that is appropriate to our socioeconomic realities and respectful of the interdependence of man and nature.

I am convinced, in light of the quality of the participants, that resolutions and recommendations will emerge from this meeting for substantial investment in rehabilitating the existing infrastructure, and that implementing these recommendations will facilitate institutional cooperation to eradicate famine and poverty in Africa.

On this hopeful note, today, 28 July 1993, I declare open the international colloquium on developing agriculture in Africa. Long live international cooperation, long live Benin's agriculture, long live Benin. My thanks to you.

Introductory Comments**

Yohei Sasakawa
President, Sasakawa Foundation
Tokyo, Japan

On behalf of the Sasakawa Foundation, I would like to express our warmest greetings to President Nicephore Soglo of the Republic of Benin, former U.S. President Jimmy Carter, former Nigerian Head of State, Olusegun Obasanjo, and other distinguished guests. I am honored and delighted to participate in this Workshop, the seventh in the series of similar consultations that we have held since 1985.

All people, I think we would concur, have the right to a decent and fulfilled life. But how can people with empty stomachs enjoy life? Until we are able to feed the hungry, all other development objectives are of little consequence. From its start, therefore, the aim of our program has been to alleviate hunger and to assist small-scale farmers to secure a better life for themselves and their families.

Our Sasakawa Global 2000 experiences in Ghana, Sudan, Tanzania, Benin and Togo, and more recently in Nigeria and Ethiopia, have demonstrated that improved food production technology developed over the past 20 years by national and international agricultural research centers has the capacity of doubling and even tripling the crop yields obtainable by small-scale farmers.

Without a doubt, SG 2000's best and most vocal supporters are the more than 200,000 farm families who have participated in the crop technology field demonstration programs that we have helped to finance. We feel a strong sense of obligation to these thousands of small-scale farmers and to the frontline extension officers who have worked shoulder-to-shoulder with them in demonstrating how improved technology can help to meet their development needs.

Although I realize that our methodologies may appear somewhat out of fashion to some, I want to clearly state that the Sasakawa Foundation fully supports Dr. Borlaug's vision and strategy for modernizing food production. We believe that many of the agricultural development lessons of Asia's Green Revolution can indeed be applied to Africa as well. Moreover, we know — as do the cooperating farmers — what is possible, especially if we seek bold solutions of a type that can radically improve the productivity of peasant farmers.

During a recent visit to Russia and other East European countries, I noticed an international trend in the donor community towards paying more attention to the newly

** Presented by Koichi Takagi, General Manager, International Affairs Department, The Sasakawa Foundation, Tokyo, Japan

democratizing nations than to the least-developed countries in the emerging regions of World. To accept this trend would, I believe, be a mistake. The industrial nations must maintain their commitment to the peoples of Africa, particularly in making a concentrated effort to get agricultural development on track.

The Sasakawa Foundation's commitment to help the nations of Africa achieve greater food security and to lift peasant farmers out of poverty is as strong today than it has ever been. Of course, it cannot be said that success has been achieved until African countries no longer need our assistance. Let me assure our African partners that we have every intention of continuing to work with you until that day is realized.

At the same time, we must ask that you recognize that we are a small, non-governmental organization with very limited human and financial resources. We cannot do everything and, though we wish we could be, we are not miracle workers. To accomplish what must be done to help Africa feed herself and offer her rural populations a chance for a better life, concerned governmental and non-governmental organizations, particularly those represented here today, must join hands all the more firmly.

Over the next three days, in addition to examining many broad issues regarding African agricultural development, we will more specifically review the status and progress of the work being done in the SG 2000 projects in Benin and other countries.

I consider it a privilege to be associated with the hard-working staffs of the Sasakawa-Global 2000 projects and the national counterpart organizations. Any success that we might claim as a donor is due to the vision, energy, and contributions of these dedicated people. I wish especially to salute Dr. Borlaug for his action-oriented mind and his untiring, always active, quest to put science and technology to work to help the world's poor live fuller, more productive lives.

Although Dr. Borlaug, President Carter and my father, Ryoichi Sasakawa, are from different cultural backgrounds, I see them as kindred spirits in the cause of peace. To each of them, a single positive action is of more value than a hundred hours of talk. Let's make our discussions over the next three days bear fruit in the form of concrete actions. Thank you very much.

Introductory Comments

Jimmy Carter
Former President of the USA

President Soglo, distinguished ladies and gentlemen of the Government of Benin, agricultural scientists, extension workers, economists, and others who support the Sasakawa Global 2000 (SG 2000) program in Benin and other nations.

It is gratifying for me to be here in a country that has truly become a model in demonstrating the movement of many African countries towards democracy. As one who is becoming a citizen of Africa, I was extremely excited in March of 1991 to see the successful move here to a true democracy when the Members of Parliament and the new President were elected by the people and to see the peaceful transfer of power from a military regime to civilian authority.

This movement in Africa was largely influenced by my friend, President Obasanjo, who served as President of his great country, Nigeria, when I occupied the White House and the Oval Office in the United States. I was privileged to come to Nigeria at that time to meet with my friend, who then pledged to honor the civilian election of his successor and he did so with complete integrity.

Although there has been some setback in Nigeria recently, it is interesting to note that, at the time I left office, there were only four countries in Africa that had moved to democracy. Now there are 14.

The trend toward freedom, democracy, and control of government by the people is inexorable and cannot be avoided, even though there will be setbacks in individual countries.

I also am grateful to see that Benin again has been a leader — indeed a model — in moving toward a free economy under the inspired leadership of President Soglo.

This is an exciting time for those of us in the United States, Japan, and Europe who observe Africa as a neglected continent, a continent that has suffered severely from past colonial domination, and that often has been robbed of an opportunity to govern itself in an economically prosperous society. And where leaders had not been trained for the difficult responsibilities of managing governments and economies in moving toward democracy, peace, and freedom.

One of the most exciting things that has happened to me is becoming involved with Mr. Ryoichi Sasakawa and his son, Yohei, and with my hero in agriculture, economics, and peace — Dr. Norman Borlaug. We began this effort in Africa following a meeting in Geneva in 1985. In 1986, we visited four countries that were carefully chosen: two north and two south of the equator — Ghana, Sudan, Tanzania, and Zambia.

There was initiated this program, which, at that time, had an uncertain future. But the essence of the SG 2000 program has proven to be very effective. Importantly, it cast its lot with the small farm families of Africa, those that have been most desperately in need and that, collectively, provide the foundation for the economy and the future of most African countries.

As President Soglo just pointed out, agriculture provides 40% of the gross domestic product of this country and more than one third of its total external earnings. A similar situation exists in most other African countries.

This program does not depend on expensive mechanization. As a matter of fact, most of the farmers in this program still plant corn or sorghum or wheat or millet by hand and cultivate with a hoe. But their yields average three times as much as their neighbors, if they follow Dr. Borlaug's scientific and practical advice.

We have had an explosive growth in numbers of farmers who have seen their neighbors' success. I remember the first year in Ghana we had only 40 farmers conducting demonstration plots. The next year, the number escalated to 1,200, the third year to 16,000, and the fourth year to too many — it increased to more than 80,000.

Now the program limits the number of participating farmers to less than 20,000 per country and we require the farm families, in effect, to graduate from the SG 2000 program after the second year if they have absorbed the techniques for obtaining such high yields of their most important food grains.

Another significant aspect of this program is that it honors the environmental consequences of increased growth. With a moderate amount of fertilizer, planting crops in rows to control erosion, and an end to the slash-and-burn technique — used in many countries when the soil is depleted after the first year — environmental consequences of food production have improved greatly.

A close partnership is not only formed but created in perpetuity, we believe, between the top government leaders — the President of the country, the finance minister, the ministers of agriculture, education, transportation, and others — so that a country's commitment can permanently benefit the scientists chosen by Dr. Borlaug.

We have perhaps only one expatriate scientist per country and several hundred extension workers supplied by the government. This not only makes the program efficient, it also deeply involves hundreds of extension workers, who then become experts in producing the basic food grains under the direction of the scientists chosen by Dr. Borlaug.

The ministers of agriculture also become acquainted with one another and benefit from the experiences derived in Tanzania, Sudan, Ghana, Togo, and Benin. This year, the program will expand into Nigeria and Ethiopia and, we hope, in the future additional countries will become beneficiaries of this program.

Later today, we will visit a community in Benin that has been deeply involved in the SG 2000 program. Last year, my wife and I were among others who visited an exciting demonstration community in Benin where farmers produced about five times the amount of maize they had been producing. They had built community storage facilities that protected their crops from moisture, insects, and rodents. They even had formed a small bank in which to deposit the profits being engendered and which they had experienced in the past. There was a strong domination of women in this success story.

(Following are highlights of other activities of the Carter Center described by former President Carter.)

I would like to close my remarks by shifting from agriculture to point out the inseparable relationships among other facets of African life. The Carter Center has a wide range of programs.

Every day, it monitors all the major wars on earth. There now are 32 major wars taking place throughout the globe, a large number of them are in Africa. With the exception of Yugoslavia, every major war is a civil war, confined to the geographical and political boundaries of a single country. People are fighting their neighbors and relatives. These are horribly destructive wars.

I look forward to a time when the Carter Center can participate as an international observer in holding an honest, open, fair, free, and safe election in Liberia, deriving from the agreement that recently has been concluded here in Cotonou under the leadership of President Soglo.

Two years ago, we monitored the election in Zambia and last year we helped with the election in Ghana. Later this week, I will be going to Togo to try to work with President Eyadema and also the political opponents in setting up a procedure for holding an honest election. So peace, democracy, and freedom in a country are inseparable. And even economic progress depends upon whether the citizens of a nation have some direct influence in controlling and managing their own government.

Another important aspect of African life obviously is health care. A task force on child survival and development, under the direction of Dr. William Foege, is located at the Carter Center. It is responsible for immunizing all the world's children and coordinates with the World Health Organization, the United Nations International Children's Emergency Fund, the United Nations Development Program (UNDP), and others. This is a great contribution, not only to the survival of children, but also to reducing population growth that is out of control in much of Africa.

Another important aspect of African life is eliminating devastating diseases that can be easily controlled. The Carter Center also has a task force on disease eradication. Under the leadership of Dr. Foege, smallpox was totally eradicated from the face of the earth 16 years ago. It was the only disease ever completely eliminated. The Carter Center has taken on itself the leadership of the effort to eradicate guinea worm — which was suffered by 10 million people, mostly in Africa, a few years ago — from the fact of the earth.

Let me close by saying that the Carter Center also is working closely with the World Bank, the International Monetary Fund, the UNDP, and others in a comprehensive approach to developing better systems. Quite often, there are so many agencies available to help a needy country that they do not work in harmony as a team. Often the needs of the country are not adequately addressed.

We hope to make some moves that will make development aid more efficient, and that will assure that the governments seeking assistance for their people can be benefited directly and incisively.

We hope those who hold debt against African countries will reduce the burden of that debt. I do not think that any country, including Benin, can make adequate economic progress when they are servicing enormous debts that have been created, quite often, by previous administrations and when much of the borrowed money went for nonproductive items like weapons to control their own people.

To me, Africa's future is quite bright and the issues in which we are involved that affect most countries of the continent inspire us at the Carter Center, particularly our involvement in the Sasakawa Global 2000 program.

Agricultural Development Strategies in Benin

Mama Adamou-N'Diaye
Minister for Rural Development
Republic of Benin

With a population of almost 5 million inhabitants, Benin faces serious economic difficulties, just like many other West African countries. Its gross domestic product (GDP), at CFA 537 billion in 1991, has not kept pace with its population growth. The 2.5% annual growth rate of GDP between 1982 and 1988 was topped by the 3% per annum population growth.

This divergence is a factor in Benin's acute economic and political difficulties experienced in 1988 and 1989. The economic crisis was caused by the political choices made in the period from 1972 to 1989 and by the global decline in prices for agricultural commodities.

In 1989, the collapse of the country's economy led the Government of Benin to implement — with the support of international financial institutions — a structural adjustment program (PAS 1) that represented a first step towards liberalization of the economy.

A second structural adjustment program restates and reinforces the objectives of PAS 1 and provides for

- reforming the Treasury and redressing the balance of payments problem
- attaining a targeted annual GDP growth of 4%
- reforming the economy to reduce the preponderance of the public sector with a parallel increase in the private sector

The need for qualitative changes to revitalize the national economy by invigorating agriculture has been proclaimed since the conference of the nation's dynamic forces in February 1990. His Excellency the President of the Republic, Mr. Nicéphore Soglo, in his action program, "Building the Benin of Renewal," defined the orientations for developing the rural sector.

This presentation is based on that program and sets out the strategy and actions undertaken since 1990 by the Ministry of Rural Development. The brevity of this report reflects concern for the audience and other speakers; it does not reflect the care with which actions are taken at the rural level. I will discuss

- the situation in Benin's rural sector
- restructuring the country's agricultural services
- our development strategy for the rural sector
- current public investment programs
- Benin's priorities and programs for the next 5 years

An Overview of Benin's Rural Sector

In Benin, the rural sector is the key one in the national economy and the foundation of any development strategy. It contributes 40% of

the nation's GDP, employs 70% of the working population, and grows at the rate of 4% per year as compared with the 3% population growth.

When rainfall is satisfactory, Benin's agriculture produces food self-sufficiency.

Farming — primarily grains and tubers — accounts for 2/3 of agricultural production; livestock is quite diversified and accounts for 22% of agricultural production; fisheries account for 3.5% of production; and forests — primarily firewood, lumber, and game — provides 7.5%.

About 3/5 of the cultivated area produces food staples (maize, sorghum, millet, fonio, yams, cassava, sweet potatoes); 9% is planted to secondary crops; 8% to groundnuts; 15% to cotton; and the remainder to other minor crops.

The annual distribution of crops varies from one region to another and is primarily related to the success of cotton, the fertility of the soil, whether yams (the main fallow crop) can still be planted, or whether only groundnuts will grow. The southern part of the country grows mainly palm trees.

The availability of land, the arborescent cover over most of the territory, the abundant hydrologic resources, the moderate geologic profile, and the range of its climate confer an agricultural potential upon Benin that provides its rural population with a fairly generous margin of safety for developing agriculture, livestock, and forestry products.

Traditional production systems are still potent and integrate production with product processing activities. These systems are appropriate to the environmental conditions and are relatively open-ended. However, they are not efficient from the crop-yield standpoint, not innovative in terms of modern equipment and inputs, and little diversified when the variability of prevailing conditions is considered.

Agricultural incomes tend to be low — 50,000 CFA to 90,000 CFA, or US$ 200 to US$ 350 a year for an agricultural worker. The use of draft animals, modern inputs, and improved methods provide increased incomes where they are used.

The Country's Agriculture Has Problems. Weak points in Benin's agriculture can be summarized as follows:

- Poor control over water supplies places agriculture and livestock at the mercy of rainfall.
- The sector's low productivity due to traditional techniques and conditions of production, slash-and-burn rotation, extensive systems of ranging and fishing, is on a par with gathering modes of agriculture.
- Support structures perform poorly, due to their long distraction from their basic mission of providing technical assistance to rural producers.
- Environmental deterioration from brush fires and inappropriate systems and modes of production limit sustainability.
- Producers get little attention in development plans; they are not prepared to take over the management of their own affairs within a reasonable period of time.
- Agricultural incomes are low, basically because of inefficient farming techniques and a dearth of appropriate technology for processing, storing, and preserving products at the rural level.
- Certain groups in society, such as women and youth, are marginalized within development plans, particularly when it comes to distributing the means of production.

- A lack of property laws restricts access to land for peasants in the south; uncertain tenure discourages most farmers from making improvements.
- The long absence of any rational, long-term agricultural policy, consistent strategy, and effective development action further worsens the condition of agriculture.

The agricultural sector has been adversely affected for a long time by the discrepancy between (1) the political decision of the State to act as the direct source of profit and well-being of its citizens and (2) the geo-economic realities that expose the people to external conditions and stimulate private initiative.

The challenges now are to determine what must be done for the future of the rural sector and to define new activities more in keeping with the interests of the national population.

Restructuring Benin's Agricultural Services

It has become necessary to restructure Benin's agricultural services to contend with unfavorable internal factors that were weighing down the rural sector.

The diagnosis of the unfavorable factors has produced a first point: the failure of the State as the producer. State policy called for the State to supplant private operators. If the policy reorientation succeeds in bringing more entrepreneurial freedom, more encouragement for the private sector, more support for peasant organizations, and more follow-up activities the chances for the rural sector will improve.

Starting in 1987, studies on restructuring agricultural services were undertaken along these lines with the assistance of partners in development, such as FAO, UNDP, and the World Bank.

These studies led to a plan to restructure agricultural services. At different stages in the plan's preparation, other multilateral and bilateral organizations displayed interest; joint funding was obtained for a total of US$ 29.6 million.

The cotton sector has been restructured and has become quite efficient in terms of the cost of fiber produced: today's level of 340 CFA per kg is competitive in the sub-region and compares well with certain regions outside Africa. The restructuring has enabled the National Society for the Promotion of Agriculture to be more competitive in external cotton markets.

Similarly, restructuring the wood industry has enabled the National Wood Office to perform better in external markets.

The National Grains Office restructuring has allowed it to move from the almost impossible task of setting the prices of farm products to enhancing food security by disseminating information about markets and setting up early warning systems.

All this restructuring is designed to make institutions more effective and less costly to operate.

In parallel, a Board of Agriculture has been set up to counterbalance State decision-making and intervention in the rural sector. The effective implementation of these bodies is under way.

Development Strategy for the Rural Sector

Benin began preparing a development strategy for the rural sector in 1989 with a study on the sector's future. In July 1990, with the Democratic Renewal, consultations and a seminar on the future of the rural sector were organized. Representatives of our partners in development, governmental institutions, and representatives of the rural communities

participated. The goal of the consultations and seminar was to carry out an in-depth diagnosis and define new orientations for the rural sector.

The conclusions that emerged from that process led to elaboration of a rural development policy document, the priority objectives of which are

- to redefine the role of the State, improving the effectiveness of State intervention, and reducing its costs
- to improve the services and infrastructures to which the rural population enjoys access
- to increase export income by improving yields and diversifying production, compensating for the weakness of domestic demand
- to combat food insecurity in the most vulnerable geographical areas and seasons
- to ensure the survival of the nation's ecological endowment through more respectful and protective management of its natural resources

The letter of intent concerning rural development policy (LPDR) of 31 May 1991 — integrating the new strategy and the restructured agricultural services — defines the policies the government intends to apply in the agriculture sector. The tasks assigned to the Ministry of Rural Development were listed in three categories:

1. Tasks exclusively incumbent upon the State, such as
   - orienting national rural development policy
   - defining strategies and programs
   - following up and monitoring the strategy's implementation, including its capitalization, disseminating information about it, and so on.
2. Non-exclusive tasks that can be carried out by the State or by other agents or trade associations, such as extension services, management consultancies, and producers' organizations.
3. Tasks of an economic, commercial, or industrial nature that are not incumbent upon the State and are to be handed over to the most appropriate agents.

Due to these initiatives, the State has embarked on development activities in partnership with all the supporting agents, particularly with non-governmental organizations (NGOs).

Current Public Investment Programs

The new policy aims to increase the effectiveness of activities in areas that have acted as bottlenecks to progress, including

- improving marketing and processing systems
- modernizing agricultural production systems
- improving the competitiveness of Benin's production for export
- updating livestock and fisheries production methods
- maintaining a healthy environment and sound management of natural resources
- creating a suitable system for providing credit
- examining the role of the State and the process of disengagement
- reviewing the context of and the methods employed by agricultural extension services
- promoting food security
- integrating rural women and youth into the socioeconomic fabric of agriculture

Several national programs provide a framework for the new rural development policy. It would be useful to briefly mention the salient points of the principal ones.

Project for restructuring agricultural services. This central project aims to reorient the institutional landscape of the rural sector by restructuring key services of the Ministry for Rural Development and the six Regional Action Centers for Rural Development.

Project for natural resources management. Jointly financed by the World Bank and United Nations Development Program, along with French and German development assistance agencies, CCCE and GTZ, the Project for Natural Resources Management defines and tests proposals (1) to introduce methods to sustainably manage agroforestry and pastoral resources and (2) to brake the depletion of natural resources. This project is part of the environmental plan prepared with the help of Benin's development partners.

Pilot project for food security. Implemented in collaboration with NGOs in a government-NGO partnership, the Pilot Project for Food Security provides an opportunity to test various approaches in its initial phase and, later, to help implement a new project for local interventions in food security, also in partnership with NGOs.

Future Priorities and Programs

We will have to tackle programs and activities with a realistic approach, assign priorities to them, and remain mindful of our limited resources. In keeping with the diagnosis carried out and the measures set forth in the LPDR, the general priorities include

- setting up community-based infrastructures required by the rural population (rural tracks, marketplaces, and communications networks, such as radiotelephones)
- developing storage capacity for agricultural produce in the villages
- disseminating information about agriculture and activities
- studying the technical and socioeconomic adaptability of technology developed in Benin and abroad
- designing coordinated programs for research and training related to the best-performing agricultural production systems
- diversifying agriculture by channeling public investment towards research, promoting exports in which Benin enjoys some comparative advantage, and adopting appropriate types of technology

In the field of natural resources management, the emphasis is on

- developing community-based forestry practices
- training, education, and raising public awareness in promoting sounder environmental management

Specific programs for livestock and fisheries promote agro-forest-pastoral integration and focus on

- developing pastoral water supplies and pursuing animal husbandry and animal health activities, particularly for short-cycle species
- developing water basins and modern techniques that upgrade fisheries' productivity

As a result of its high priority and sensitive nature, food security calls for programs directed towards combating food insecurity in high-risk areas through income-generating and community-development activities.

Actions to promote the socioeconomic integration of women and the employment of youth will also be given priority in targeted social programs.

Agricultural Diversification Receives Special Attention. Benin's agro-economic conditions support a wide range of potentially exportable agricultural products. However, as the market has become increasingly competitive, traditional products (palm oil, coffee, groundnuts) have not been able to hold their ground. Forest products, such as karite and cashew, occupy a marginal position owing to irregular production and inadequate marketing channels.

Export diversification, primarily directed towards finding new outlets, has become a priority, and several leads will be worth following if there is a willingness to break new ground.

Some of Benin's market produce already enjoys a reputation for quality that could be exploited further. This is the case for gari, for example; it enjoys increasing demand in African countries that do not employ that particular technique for processing cassava.

European countries are trying to diversify the composition of their livestock feed and seem to be interested in regular supplies of cassava pellets.

Inland countries of Africa that often suffer seasonal food shortages occasionally appear as grain purchasers on Benin's markets, but this tends to occur at periods that are inconvenient for Benin.

For Benin to be self-sufficient and have a surplus to sell on external markets, agricultural yields and productivity will have to be improved.

This is why the results generated by applying the technology packages recommended by the Sasakawa Global 2000 project have a decisive impact on farmers who see yields of a crop like maize double, triple, and even quadruple. These activities deserve to be pursued.

Further downstream, we must increase our efforts to protect the improved incomes generated by increasing production through better techniques for storing, marketing, and processing farm produce.

Conclusion

Today, agriculture in Benin faces many challenges, including solving the unemployment problems of both uneducated youth and jobless graduates, improving rural incomes, and making Benin's products more competitive abroad. Thanks to the support of some of its development partners, the Government of Benin has created rural promotion centers that provide training for young people who will set themselves up as independent producers after completing the courses.

While these young men and women have the will and the technical know-how to get started in the rural sector, the lack of credit availability is a heavy handicap to overcome. Similarly, it cannot be taken for granted that the means, particularly financial, are available for transferring knowledge and responsibility to the farmers' organizations or to others in the private sector.

Finally, the lack or inadequacy of basic infrastructure means that the potential of Benin's agricultural sector is under-utilized.

Through the government's manifest will to make the agricultural sector the foundation of the national economy, to redress that economy, and to allow each participant to play his part we hope to be able to meet these challenges. We are confident that the support of our multilateral, bilateral, and NGO development partners will not be lacking.

Agricultural Development Strategies in Togo

Nicolas K. Nomédji
Minister for Rural Development
Republic of Togo

Your excellencies the presidents, your excellencies the ministers, distinguished delegates, ladies and gentlemen.

After Arusha, Tanzania in 1991, and Virginia, USA in 1992, today we are meeting in Cotonou, Benin to pursue our collegial thinking on agricultural development in Africa.

Allow me first of all to tell you how much we appreciate these periodic consultations on the problems in the agricultural sector. I take this opportunity to thank everyone who has contributed to the organization and success of these meetings.

It is my pleasure to express our heartfelt thanks to President Jimmy Carter, to Mr. Ryoichi Sasakawa and to his son Yohei, and to Dr. Norman Borlaug, whose unfailing solicitude bears witness to their firm resolve to act in concert with us to improve the living conditions of our people.

Our thanks also go to the authorities and to our brothers in Benin for the warm, fraternal welcome and generous hospitality we have been enjoying since we arrived in this beautiful country.

You have invited me to address this assembly about agricultural and rural development strategies in Togo. My statement will be ordered along the following lines:

- Characteristics and potential of Togolese agriculture
- Earlier strategies and their results
- Togo's new strategy for rural development
- Activities in our rural development strategy

Characteristics and Potential of Togolese Agriculture

As you know, the agricultural sector is the foundation of Togo's economy and the prime engine its growth. Agriculture employs 75% of the work force and provides about 30% of export earnings.

Farm crops represent 74% of total agricultural output, while livestock, fishing, and forestry provide the remaining 26%.

Food crops (maize, sorghum, millet, groundnuts, beans, cassava, and yams) make up 64% of farm production and cash crops produce another 10%.

Togo's three main export crops are coffee (17,300 tons in 1991), cocoa (8,700 tons) and cotton (100,600 tons); they constitute 25% of total exports and provide some 10% of State income.

The above total production was achieved by some 300,000 farming families cultivating about 900,000 hectares annually, with an average financial investment for the sector of about US$ 11 billion a year for the past 5 years.

However, with the exception of cotton, overall growth in the sector has fallen short of the target for the past 20 years, despite all the efforts we have deployed.

Togo's farmers are small-scale producers or traditional peasants, functioning at a low level of economic organization. They still use archaic techniques and tools for cultivation and production is hostage to atmospheric conditions. Small family plots, less than 2 ha on average, benefit from extension services that have been reorganized repeatedly to promote grassroots development.

Earlier Strategies and Their Results

A brief presentation of the results and progress achieved to date will provide a base for measuring the fruits of past efforts and sacrifices and serve as a benchmark of the challenges that remain in our endeavors to meet our food requirements.

The overall national guidelines drawn up since Togo's independence were designed to

- secure food self-sufficiency by stimulating food and animal production
- promote production of cash crops such as coffee, cocoa, cotton, and oil palm through technical and financial support for the relevant structures created for that purpose

As regards food self-sufficiency, significant surpluses of maize (67,000 tons), sorghum-millet (371,000 tons), yams (405,000 tons), and cassava (408,000 tons) were recorded in 1989. However, at 11,400 tons, rice production was clearly short.

While self-sufficiency in protein of vegetable origin has been attained to some extent, such is not the case for animal protein. However, Togo can boast of three ranches (Adele, Namiele, and Bena Development), a research and breeding center at Avetonou, and several projects to promote short-cycle species — sheep, goats, and poultry.

Fish production was almost 15,400 tons in 1989, but Togo continues to import over 2 billion francs worth of fish every year.

As for forestry, some 20,000 ha have been replanted to trees to date.

Because of its focus on food self-sufficiency and improving the standard of living of its people, Togo has warded off hunger and engaged in a modest program of exporting its agricultural surpluses. It has sold maize twice on a triangular basis to countries in the sub-region.

With Togo's population of 3.7 million growing at an annual rate of about 3%, it can expect to have about 5 million inhabitants by the year 2000.

Faced with the challenge of providing secure food supplies for such a population — while improving living conditions — the Togolese Government has centered its agricultural development policies on growth in the sector and on creating a congenial and stimulating economic environment for the sector's active operators.

In this context, it will be necessary to (1) deal with the multiple constraints to disseminating improved know-how, (2) settle land ownership claims, (3) provide adequate services to farmers, (4) promote rural credit, (5) strengthen research institutions, and (6) develop the necessary infrastructure. These are the themes of Togo's New Strategy for Rural Development (NSDR).

Togo's New Strategy for Rural Development

The Government of Togo has embarked upon the NSDR to consolidate our gains and coordinate production activities.

This strategy dictates the philosophy and activities underlying our rural structures and is designed to

- refocus rural development activities on the farmer, who is both the main actor and beneficiary of the development process
- implement measures to increase and diversify production
- improve and strengthen the structures supporting agricultural production
- promote the people's participation in development and the empowerment of grassroots communities
- combat poverty and malnutrition in geographically disadvantaged areas
- contribute to the well-being of farmers by increasing their incomes and enhancing their living conditions
- protect and restore natural resources and the environment for sustainable production
- contribute to the balance of payments by developing crops for export

To attain these objectives, the government has taken the following measures, which are briefly sketched out.

Togo is Pursuing Land Reform. The promulgation on 6 February 1974 of Ordinance No. 2, enacting the agro-land reform, was necessary to facilitate access to land, the fundamental basis of agriculture.

Unfortunately, implementing the reform was hampered by certain obstacles. One was a failure to adequately prepare the farmers. Another was a misunderstanding by the people of the purposes of the reform. Yet another was resistance arising from rural sociological realities.

Adjustment and the pursuit of reform are essential for better utilizing Togo's land assets.

The Rural Environment Will be Restructured. In order to attain the above objectives, the rural environment will have to be restructured by organizing farm producers, promoting agricultural groups, training the members, and enhancing functional literacy. Governmental administrative structures should be reorganized to improve their performance and adaptability, and to strengthen their impact on rural areas.

These policies should support the option of state disengagement.

This is why the National Service for Cooperation, with the assistance of other administrative structures — such as the Regional Directorates of Rural Development — is promoting and expanding the cooperative movement in the rural sector. The cooperative movement then can improve farmers' organizational abilities and help them acquire the technical means they need, but which are expensive and beyond the reach of individuals.

We now can boast of 1,047 viable groups with about 54,000 members. There are also 17 marine fishing cooperatives, four handicraft cooperatives, 200 informal groups followed by non-governmental organizations, and 100 savings and loan cooperatives.

This encouraging tally justifies increasing and strengthening our activities to create further groups. Our Head of State recently has invited us to do so and, in keeping with the principle that "Unity generates strength," he has asked us to base our agriculture on the cooperative movement as the indispensable catalyst for organizing rural production.

Today, the National Service for Cooperation is defining the principles for supporting the groups' establishment, functions, and activities. Legislation for cooperatives is being drafted.

Actions Will be Taken to Benefit Youth. The nation's youth are another of the government's concerns. Idle young people, who often leave their villages in search of hypothetical jobs, are a potential source of labor for the rural sector — labor that is needed to strengthen our agriculture and make it more dynamic.

This is why it is important to train young farmers and have a program to help them get established. This supports the growing importance of private initiative in national development. Further, we are studying a professional program for young agronomy graduates from schools of agriculture.

The objective pursued by the new strategy, as well as by the program to establish the youth, is to create a new class of agricultural entrepreneurs who are self-starters and self-managers and who are able to become economically successful.

The Role of Women Will be Strengthened. Women are among the agents of our development, whose ardor at work and determination in the struggle against hunger deserve the attention they have been given in Togolese politics.

No one in this audience is unaware of the role they play in Togo's economic and social development, and how actively they participate in production activities. This is why the New Strategy for Rural Development aims to:

- strengthen the organizational tools available to women so that production and management of the fruits of their labor occur on a collective, cooperative basis
- improve techniques for processing and storing farm products in order to save women's time and improve the profitability of their labor
- take women into account in the redistribution of land under the agro-land reform
- emphasize support and training of women in order to improve their agricultural productivity and help them attain food self-sufficiency
- create women's sections in development programs and projects

My government's commitment to these goals has been restated in the fourth Structural Adjustment Program negotiated with the World Bank and the International Monetary Fund.

Actions in Pursuing Our Rural Development Strategy

Having set out the general outline of our rural development policy and described a few of the results, I now would like to indicate the main directions and features of present and future action. Two types of earlier measures continue to be applied.

The first type is applied to the agents of development — the peasant masses who can become a productive force only if they are properly organized. These groups will be supported as they form and will be assisted in consolidating and strengthening their production and marketing activities.

The second type of measures concerns the organization and administration of the services that are offered to farmers. Bringing the farmers up to present economic and technical standards requires proper trainers and efficient dissemination of new techniques.

Quite obviously, not every farmer can be given direct assistance or our efforts will be spread too thin and lack impact. This is why we target groups of producers that are receptive to innovation and who can influence other farmers. We reach out to the greatest number of beneficiaries by placing responsibility for assistance in their respective zones to the Regional Directorates of Rural Development (DRDR) and the other development organizations.

Today, the program has 1,368 operational zones with a ratio of one assistant for 200 farmers, 175 subsectors, and 37 sectors.

Improved productivity. We consider improved productivity and technical progress to be essential in meeting the increasing demand for food created by the rapidly growing population.

Agronomy research is focused on applied testing that combines thematic and program approaches to research and development.

Distributing inputs. A policy will be required for distributing inputs. For example, market crops receive little fertilizer as compared to cash crops. More than 90% of the fields planted to cotton are fertilized but only 8% of the area growing market produce is fertilized.

In the past, the Government of Togo introduced and maintained a sizable subsidy for fertilizer to encourage its use but the changing economy and the structural adjustment program demand a progressive rollback of subsidies on fertilizer and insecticides.

Seed production. Measures to improve conditions for producing seed include

- development of improved varieties through research at the various stations
- production of foundation seed at the Sotouboua Seed Farm, whose capacity can cover our needs
- multiplication of seed for general distribution by specialized farmers assisted by DRDR and development societies

Animal traction. Animal traction is well suited to our conditions and it was promoted on a large scale in appropriate areas through credit on soft terms until 1987. We now have about 8,900 teams of draft animals.

We must master this technology. The Government of Togo is anxious to strengthen the impact of the Project for the Promotion of Animal Traction and to find a substitute for the National Agricultural Credit Bank (CNCA), for the suspension of its activities has slowed the development of animal traction.

Farm credit. The government is concerned about expanding an essential collateral asset: farm loans. The CNCA, created in 1967 to finance the equipment and inputs required for production and to provide resources for processing and marketing products, encountered grave difficulties and its activities were suspended.

Setting up a new system to provide farm loans is taking a long time. Doubts exist about the nature and responsibilities of the future institute, to be based on the principle of mutual ownership. The government intends to accept the responsibility for facilitating efficient and viable rural financing.

Farm produce marketing. Increases in farm production will require organizing marketing channels, finding outlets, and developing domestic and external trade in order to improve farmers' incomes. To this end, the government has set up an export liberalization mechanism for grain and other farm products.

The question of marketing food crops will retain our attention for a long time — until some significant improvement is noted.

In the same way, there are problems with processing local products. They remain a major concern of the government, which will intensely promote such products in keeping with an action plan that will be developed on the basis of the results of a study of relevant points.

Livestock production. To reduce the shortfall in livestock production, short-cycle animal species (such as small ruminants, poultry, and pigs) will be promoted. Upgrading the traditional sector will be emphasized.

Also worth noting is the integration of agriculture and livestock, with an accent on animal traction for plowing, planning pastures, developing fish culture, and improving both marine and inland small-scale fishing.

Forestry activities. The government has programs to encourage replanting trees. The Day of the Trees aims to create forest plantations around the big cities and urban centers. A forestry plan of action to preserve and improve the natural forest resources will be implemented in 1994. The energy problem has intensified these activities.

The current Tropical Forest Plan of Action is a timely study that will help us define sound forestry policies with clear-cut objectives and elaborate a solid program. The program will take into account the balance among ecosystems to better protect the environment for sustainable development.

I cannot conclude without mentioning how our production depends on variations in atmospheric conditions. Water remains a major constraint to our agriculture, and it is imperative that we control it better. We must accent making downstream improvements with the beneficiaries participating.

The SG 2000 project is one initiative whose approach is entirely in keeping with our agricultural policy; it makes a satisfying contribution to staple food production, particularly maize.

I take this opportunity to again thank the Sasakawa Africa Association, as well as all the friends who support Togo in its development efforts.

Allow me to conclude by reminding you how much interest we attach to the work of this august assembly. We are convinced that it will lead to pragmatic and operational recommendations.

Long live international cooperation.

The Sasakawa Global 2000 Project in Benin and Togo

Dr. Marcel Galiba
Benin/Togo Country Director

We recognize that Africa is the continent where the Malthusian race between population and food is a tragic reality. The figures tell the story: from 1980 to 1990, when agriculture grew 1.4% per year, population growth rate jumped to 3.1% per year.

For more than 20 years — from 1961-65 to 1984-88 — all social, economic, and ecological indicators have declined in Africa. Three major factors accounting for this decline were cited by Robert McNamara in 1990 at the Africa Leadership Forum in Nigeria: they are agriculture stagnation, the population explosion, and environmental degradation.

The increase of imports (4%/year since 1974) and food aid (7%/year since 1974) cannot be permanent solutions to food deficits when earning foreign exchange becomes more difficult and uncertain each year. Bringing improved technology to small-scale farmers is the only viable way to halt the decline of African agricultural production. That brings us to the role of the Sasakawa Global 2000 Agricultural Project (SG 2000) in Benin and Togo.

Basis for SG 2000 Program in Benin and Togo

Small-scale farmers' hopes and productivity can be restored by giving them sound agricultural technology that fits today's needs and that is sustainable. The SG 2000 project, started in 1986 in Ghana and Sudan, aims to do just that. Its mission is to do something about the deep roots of Africa's food crisis.

The project in Benin and Togo was initiated as a spillover of the Ghana project. Seeking to expand the SG 2000 technology transfer approach from Ghana to neighboring countries, Benin and Togo appeared on the horizon. They are geographically close, share similar agroecological zones, and have the same cropping patterns with maize, sorghum, and millet — the mainstay cereals. A field testing program for improved technology was established in Benin in 1989 and Togo in 1990.

Benin and Togo Are Similar, Yet Different. Benin and Togo can be considered as sister countries, although they have different colonial pasts. They both gained independence at the same time. However, their march toward development and freedom in the second half of this century diverged significantly.

While Benin moved to the Marxist regime, Togo consolidated her liberal approach, avoiding hard times and upheaval. Today it seems the tide has reversed: Benin, after rejecting her Marxist past, is enjoying the achievements of her democratic transition; Togo is beset by political unrest, strikes, and people fleeing their native land because of insecurity.

Table 1 confirms the great similarity of both countries: high population growth, low per capita income, high level of adult illiteracy, dominance of agriculture, and high levels of food imports and food aid. In a nutshell, both countries, despite divergent political choices in the past, today share common goals that start with satisfying basic needs, namely food, health, and shelter.

SG 2000 Has Strong Leaders and Collaborators. The SG 2000 projects result from joint collaboration between the Sasakawa Africa Association (SAA) and Global 2000 Inc. SAA was created by the Sasakawa Foundation, whose chairman is Mr. Ryoichi Sasakawa, well know for his commitment to international aid and assistance "not as charity but as support and encouragement essential to realizing people's vision and self-fulfillment." The president of SAA and leader of all SG 2000 projects is Dr. Norman Borlaug, 1970 winner of the Nobel Peace Prize and widely recognized as the father of the green revolution in Asia. Global 2000 Inc., headquartered at the Carter Presidential Center in Atlanta, Georgia, USA, is chaired by former United States President Jimmy Carter. Christopher Dowswell, is SAA director for program coordination. The program takes a collaborative approach with host countries.

Host Country's Role is Critical to Success. Small-scale farmers must have good, reliable, sustainable economic returns to their efforts. SG 2000 demonstrates the feasibility of increasing productivity of food crops by introducing simple and proven agricultural technology to participating farmers.

The host country's role is critical to the success of such an endeavor. In the case of Benin and Togo, strong relationships were developed with the Ministry of Rural Development in each country and with the Departments of Extension and Farmers Organization. SG 2000 works directly with the Centres d'Action Régionale pour le Développement Rural

Table 1. Profile of Benin and Togo.

	Benin	Togo
Position	6° to 12°N Latitude	6° to 12°N Latitude
Area (km^2)	115,762	56,500
Regions/Departments	6	5
Population (1991) (millions)	4.7	3.6
Population growth (%/year) (1980-90)	3.2	3.5
Agricultural population (%)	68	71
Agriculture growth (value added) (% 1990)	1.4	-1.2
Agriculture's share in GDP (% 1990)	37	33
Cereal yield (t/ha) (1989)	0.9	0.9
Fertilizer consumption (1989-90 (kg/ha)	1.8	8.3
Cereal input 1990 (thousands of tons)	126	111
Food aid 1989-90 (thousands of tons)	13	11
Adult illiteracy (%1990)	77	57
Per capita income (US$)	360	410
GDP 1990 (million US$)	1,810	1,620
External debt 1990 (million US$)	1,427	1,296

Source: FAO Production Year Book 1991.
World Development Report 1991.

(CARDERs) in Benin and the Direction Régionale du Développement Rural (DRDR) in Togo — the agencies in charge of extension at the regional level.

No parallel structure is created; the organization structure is simple. In each country, national and regional coordinators and frontline staff in the field belong to the ministry. Staff of the Ministry involved in the project may participate on a part- or full-time basis. The activities of SG 2000 are part of the overall agricultural program of the country, it is not an entity apart from the Ministry's activities.

Logistics and allowances are provided to the collaborating staff. National coordinators work full time with the project and submit quarterly progress reports to the Ministry. They are provided with pickup trucks.

Departmental/regional coordinators, as well as technical officers, do not work full-time with the project. Some technical officers are provided motorbikes and an allowance to facilitate their work, but they must repay the price of the motorbike, which finally becomes theirs. Those without motorbikes receive a monthly travel allowance.

Improved Technology is Based on Research. The improved technology is a simple package based on national and international research. Its components include row planting, improved varieties, moderate application of chemical fertilizers, timely agronomic practices, and effective post-harvest practices.

For example, participating farmers plant maize at a density of 62,500 plants/ha. They apply compound fertilizers (14-23-14) and urea in order to have a total amount of 74-46-28 kg/ha of NPK. Appendix 1 gives details of recommended agronomic packages.

The underlying assumption is that the improved technologies can double or triple yields without endangering the natural and human resource base.

To combat land degradation and restore soil fertility, we encourage use of a green-manure cover crop. Our choice is velvet bean, a grain legume that can play a major role in the rotation and also is aggressive enough to smother speargrass, a weed plaguing most of the soils in southern Benin and Togo.

In crop selection, we target cereals — namely maize and sorghum, which have been cropped for centuries — because of their importance in both countries. (Benin has the highest per capita use of maize in West Africa: 83kg/year).

Making farmers aware of and creating new attitudes towards improved technology helps introduce innovation to other commodities, such as cowpea, cassava, and yam.

Production Test Plots Demonstrate the Package. To be successful with small-scale farmers, new technology not only must be simple but it must be affordable and profitable. Interested farmers must be able to try it in their own environment.

The whole-field strategy is based on the premise that "what a farmer hears, he rarely believes; what he sees on somebody else's plot, he can doubt; but what he does himself, he cannot deny."

The field program turns around a basic unit called the production test plot (PTP), where the recommended package is tested against farmers' traditional practices. It works this way: half a hectare (5000 m^2) is required to demonstrate the improved methods and another half a hectare carries the farmer's traditional plot. Thus, farmers can assess the technology before they decide whether to adopt or reject it.

Basic inputs, mainly improved seeds and fertilizer, are provided on a credit basis. The loans are repaid in kind or cash after harvest.

However, SG 2000 is not a credit program. We extend credit to collaborating farmers so they can apply the whole package of technology to give it a fair and realistic examination. It also allows farmers, at the end of the season, to evaluate the technology in terms of monetary return. Rate of loan recovery can be a measure of the technology's success.

SG 2000 is not involved in land acquisition and preparation; they are part of the farmer's commitment.

Farmers Help Extend the Technology. Farmers are required to belong to a group in order to join SG 2000. They arrange a starting nucleus. Benin and Togo have long experience with farmers' cooperatives, so participants were invited to take advantage of that experience in forming the starting nuclei; there was no need to dismantle existing organizations with the same goals but to bolster them with good training and information.

There are many reasons for working with groups. Group members can interact frequently in assessing the technology. They get the sense of belonging to something. Late adopters change their attitudes more readily by observing their neighbors' success.

Other pluses of collective action include joint liability. Farmers have the group as collateral for loans; recovery of input loans becomes less thorny as compared to dealing with dispersed individual farmers. Technical officers work more easily with organized entities and also know where to turn in case of disagreement or misunderstanding.

Extension messages on block farms of 30 ha or more can flow more easily, compared to scattered half-hectare plots. And peer pressure can support extension work and even bring a bit of competition.

We expect each PTP farmer to invite at least 10 neighboring farmers to form a cluster that will observe the package and help diffuse information about the results. Farmers' active participation in the extension process is important. The PTP belongs to them, not to SG 2000; they are directly involved, participating in all the agronomic practices.

Field days are organized during the growing season, involving PTP farmers, farmers' clusters, and other visitors. The communication proximity — the degree to which two individuals have an overlapping communication network — is high between members of the same village. Therefore, information moves from the PTP farmers (and technical officers) to the farmers' clusters and vice-versa.

A Graduation System Was Applied in 1991. SG 2000 focuses its activities on introducing improved crop production and on post-harvest technology. The project becomes a learning place, where farmers become aware of available technology and obtain new know-how they can use forever. So, as a learning place, there comes a time for graduation.

In 1991, a graduation system was formally applied. The sequence works like this. Farmers receive 100% of inputs on credit the first year. The second year, through cooperative action, they must capitalize and finance 50% of their input needs; SG 2000 supplies the other half on credit.

Graduation occurs the third year, although SG 2000 continues other forms of assistance — mainly post-harvest technology and cooperative training regarding savings.

A group as a whole is with the project for 3 years. However an individual farmer cannot participate in a maize/sorghum PTP for more than 2 years.

SG 2000 Program Experience in Benin and Togo

Following is a review of the projects' experiences in several categories. This section and the next indicate the many lessons that experience has taught us.

Number of PTP Participants Grew Rapidly. SG 2000 and Ministry of Rural Development extension personnel started the project with 63 farmers in Benin in 1989. Three years later, 3,245 farmers participated, divided into two groups: 1,384 were considered as second-year farmers and 1,861 were starting their first year.

In Togo, the project started one year later with 73 farmers. The total number of farmers in 1992 was 988, comprised of 549 first-year growers and 439 second-year producers (Table 2).

In both projects, the largest increase occurred in the second year, following the first pilot year. Both projects started cautiously; we needed to know the people and the environment and to have time to explain our strategies. Later, the rate of increase became smaller for several reasons, the most important of which were the limit of available manpower, logistics, and budget constraints. After they learned of the first year's results, more farmers wanted to join than we could accommodate.

The number of farmers per technical officer is important. In 1992, the ratio was 25 for Benin

Table 2. Production test plots in Benin and Togo from 1989 to 1993.

Country	Region/ Department	1989	1990	1991	1992	1993*	Total
Benin	Atacora	10	402	715	864	800	
	Atlantique	9	180	270	295	364	
	Borgou	14	401	765	777	771	
	Mono	10	185	427	373	422	
	Oueme	10	170	223	239	347	
	Zou	10	400	775	697	896	
Total		63	1,738	3,175	3,245	3,600	11,821
Technical officers		63	69	90	131	140	
Togo	Maritime	-	11	100	260	98	
	Plateaux	-	32	86	278	86	
	Kara	-	30	301	401	255	
	Savannes	-	-	-	49	49	
Total		-	73	487	988	439	1,987
Technical officers		-	25	50	59	69	
Total PTPs (Benin + Togo)		63	1,811	3,662	4,333	4,039	13,808
Technical officers (Benin + Togo)		63	94	140	190	199	

* Projections.

and 17 for Togo. We have learned that we should not burden technical officers with too many farmers. In many extension programs, the ratio runs as high as 200 farmers or more per technical officer. That makes close and efficient supervision of farmers impossible.

Including PTP projections for 1993, nearly 12,000 PTPs will have been conducted in Benin and nearly 2,000 in Togo. The number decreased significantly in Togo in 1993 because of the uncertain political situation; 1,500 farmers were budgeted but the program was reduced to only second-year PTP farmers until graduation. Hopefully, the political situation in Togo will allow SG 2000 to resume full operation in 1994.

SG 2000 farmers generally are landowners. However, there are more landowners in the north than in the south, particularly in Togo where tenants are more prevalent (Table 3).

Landowners are more willing to take a risk and try an innovation. Landless farmers hesitate to make an investment in fertilizer, not knowing when landlords may come and take back their lands. Farmers strongly believe in fertilizer's residual effect and may feel cheated to leave the fertilized land to someone else.

Tenants' reluctance to adopt new innovations increases when long-term actions are proposed. For example, it is difficult to convince landless farmers to plant a green-manure crop.

Table 3. Land ownership among PTP farmers*.

	Benin	Togo
North %	90	87
South %	76	32

* Data recorded from the PTPs program come from more than 2,500 farmers in Benin and 500 in Togo.

In a few cases, farmers completely refused to use fertilizers; they believe fertilizers have a negative effect.

Plots Are Large Enough to Show Profit. The recommended plot size was to demonstrate the technology — credit was not extended for increasing total farm production. Many large commercial farmers expected loans for inputs on more hectares and were disappointed to realize that a social share gives access to only half a hectare and no one could have more than one social share.

The half-hectare PTP size is big enough, not only to assess the package, but also to bring comfortable returns to farmers. Farmers ended up realizing that big plot size — with poor technology and inadequate husbandry — does not always mean high yields.

In both countries, slash-and-burn is the most rampant way of preparing the land for crops. More than 75% of SG 2000 farmers used a cutlass and hoe to prepare their land. In the southern regions — namely Atlantique and Oueme Departments in Benin and Maritime in Togo — the percentage is above 95%. In northern regions — namely Borgou in Benin and Kara in Togo — farmers have access to animal traction.

Where trypano-resistant bullocks are available, animal traction can be introduced and encouraged in the south. In Benin, the Association pour le Developpement des Initiatives Villageoises initiated a successful experience with the manga hoe, which uses only one bullock instead of two.

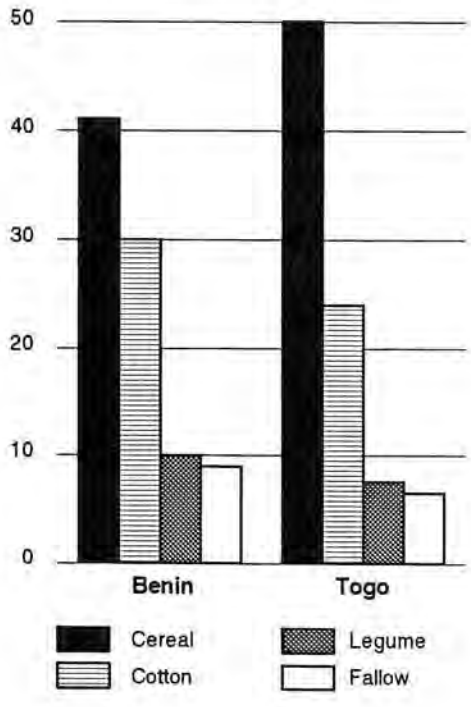
Farmers can increase their farm size if they have an extra source of energy, which, for the time being, can come only from draft animals. The use of tractors is not recommended — and to some extent must be avoided — considering the fragility of the soils, lack of

mechanical competence and spare parts, and the high cost of such machines.

Soil Fertility is Being Degraded. Farmers generally plant cereals after cereals in Benin and Togo. Overall, between 45% and 50% of PTPs were preceded by maize or sorghum (the figure was as high as 84% in Atlantique Department of Benin). Cotton, mainly in the north, comes next as the preceding crop, with an average between 20% and 30%.

Two striking observations are evident from these cropping patterns: (1) small amounts of legumes precede cereal crops (less than 10%); and (2) critically important fallow periods are disappearing (Figure 1). The data clearly show the breakdown of shifting cultivation. Fallow periods are getting shorter and shorter, if they are present at all.

Figure 1. Crops preceding PTP in Benin and Togo (percent frequency).



It is not surprising that soil fertility is being seriously degraded, considering the low use of legumes, the quasi-permanent use of cereals, the absence of fertilizer use (except in northern areas with cotton), and the growing population pressure.

Given the physical and chemical properties of the ferruginous and ferralitic soil of Benin and Togo, strong action must be taken to stop degrading soils. Simple rotations must be included in the farming systems. Many reports show the beneficial effect of groundnut, cowpea, pigeon pea, and yam as preceding crops, and reinforce the idea that maize is a bad preceding crop and sorghum is even worse.

Intercropping Maize with Cassava Looks Promising. Intercropping maize and cassava was compared to maize monocropping. Yields as high as 3,800 kg/ha were observed in some intercropped plots, mainly in Zou in the central part of Benin. The presence of cassava did not adversely affect maize yields, making intercropping a good way to have the best of both crops. Yields of 8 t/ha and 14 t/ha were observed for TMS 30001 and TMS 30572, respectively — two improved varieties from IITA.

Despite the good news about intercropping of maize and cassava, research conducted on savanna soils in Ghana showed that intercropped maize-cassava is equivalent to a maize preceding crop. A fallow or legume should follow a maize-cassava intercrop before planting maize again. An improved fallow with a cover crop will be welcome.

Recommended Technology is Readily Accepted. With close supervision by motivated extension officers, PTP farmers were enthusiastic about the recommended technology. In both countries, row planting had been accepted before the project started,

due to cotton cultivation. The striking novelty to farmers was using fertilizer on cereals.

Encouraged by some agronomists who believe in the so-called miraculous after-effect of cotton fertilization, many farmers refrained from fertilizing their maize. They rediscovered the benefits of nurturing their maize. That became accepted as the magic.

We stress to farmers that cereals need to be fertilized; nitrogen is the limiting factor most of the time, although phosphorus is needed widely, and potassium is needed in the south. The methods of applying fertilizer served as a bottleneck. We recommend that urea be pocket-applied and covered; we don't allow broadcasting on the soil surface. A watchful attitude is required to get some PTP farmers to follow the correct practice.

Among other agronomic observations is that plant density almost always is under the recommended level — usually around 75% of optimum. Maintaining correct density within the row is more difficult than between rows; farmers tend to widen the space between plants in a row.

PTPs Increased Yields and Profitability. PTPs consistently outperformed traditional farmers' plots from 1989 to 1992. The highest average yields were recorded in the northern regions like Atacora, Borgou, and Kara. Response to fertilizers and improved husbandry were also significant: yields were at least doubled in Atlantique, Maritime, Mono and Oueme (Table 4).

In some cases, farmers did not use the full dose of fertilizer recommended. An average of 2,100 kg/ha of NPK was observed in 1992 in Benin — higher than with the traditional technology, but below recommended levels. However, the difference between the use of improved varieties and the use of improved varieties with NPK was not always significant. It takes, particularly in the south, additional nitrogen to get the full benefit of the recommended packages.

Yield data are adjusted to 15% moisture content and 75% shelling percentage, assuming harvest at 25% moisture. A correction factor of 0.6617 is used to transform maize on the cob to maize grain. Three replications of 100 square meters were

Table 4. Yield of maize PTPs compared to farmers' plots (FP), 1989 to 1992.

Country	Region/ Department	1989	1990	1991	1992	Average 1989-1992		% Gain
						PTP	FP	
Benin	Atacora	3,460	3,300	4,000	3,900	3,662	1,000	266
	Atlantique	2,140	2,400	12,700	2,660	2,475	1,040	138
	Borgou	3,700	2,900	3,000	3,800	3,350	890	276
	Mono	3,200	2,550	2,000	3,100	2,737	1,100	149
	Oueme	2,250	2,600	3,600	3,100	2,887	860	328
	Zou	3,000	3,000	2,000	3,600	2,900	1,100	173
	Mean	2,973	2,792	2,883	3,360	3,002	998	200
	Maritime	-	2,800	2,900	2,750	2,817	1,150	145
	Plateaux	-	2,200	3,600	4,900	3,567	1,880	90
Togo	Kara	-	2,700	4,100	4,000	3,600	1,700	112
	Mean	-	2,567	3,533	3,883	3,328	1,577	111

harvested and weighed in each PTP. Percentage gain was calculated as follows: [(PTP - FP)/FP] x 100. (FP is the yield of the farmer's traditional plot.)

Using Part of the Package is Risky.

Partial budget analysis was done using average maize PTP yields for 1989-92. Marginal rates of return to the additional investment were found to be 169% and 175%, respectively, for Benin and Togo (Table 5).

The full technology pays off. However, using only part of the package, such as less fertilizer or even only improved seeds is risky. Planting improved seeds at a higher population density without fertilizer and proper rotations — following maize with maize and skipping a fallow period — is not a sound investment in the long term; it ruins the soils.

Beyond yield measurements, it may not be feasible to evaluate the cash effect of supplying fertilizer. However, it is obvious that good cultural practices and raising soil fertility help safeguard and protect soils. The use of only NPK (28 kg/ha) may work in more fertile soils of the north but could be risky and not efficient in the degraded soils of southern Benin and Togo.

Table 5. Partial budget analysis of maize PTPs in Benin and Togo.

	Traditional plots		Production test plots[a]	
	Benin	Togo	Benin	Togo
Average Grain Yield kg/ha	1,000	1,600	3,000	3,300
Variable costs				
Seed : cfa/ha[b]	-	-	2,600	2,600
Fertilizer[c]				
NPK, cfa/ha	-	-	18,000	13,000
Urea, cfa/ha	-	-	9,000	6,500
Additional labor[d]				
Person-days/ha	-	-	20	20
@ 750 cfa/day	-	-	15,000	15,000
Total:				
cfa/ha	-	-	44,600	37,100
Gross value of output[e]				
cfa/ha	60,000	96,000	180,000	198,000
Net Additional Profit				
cfa/ha	-	-	75,400	64,900
Marginal Rate of Return to Additional Investment (%)	-	-	169	175

[a] Production Test Plots : Improved OPV, row planting, weeding, NPK+urea application, rate of 74-46-28 kg/ha
[b] 20 kg/ha @ price of 130 cfa/kg of improved OPV seed.
[c] NPK and Urea price = 90 cfa in Benin, 65 cfa in Togo.
[d] Additional labor for line planting, weeding, fertilizer application, harvesting, shelling and storing.
[e] Maize grain price = 60 cfa/kg. Average yield 1989-92.

This introduces the topic of what we call technology menus. A more customized approach to fertilizer quantity, type, and method of application will help farmers better capitalize on their investments. Findings of studies by national researchers will be needed to fill this need.

Some PTP Farmers Are Organizing Groups. PTP farmers involved in the project have formed associations, groups, or cooperatives. The Department of Cooperative Action of the Ministry of Rural Development has assisted in this effort. In 1993, some 193 farmers groups with 3,315 farmers are operating in Benin while there are 48 groups with 939 members in Togo.

Membership fees and social shares were used as criteria to assess group efficiency. Nearly all farmers have paid their subscriptions as well as their social shares.

A pilot project concerned with rural savings and loan funds is a case in point. It was initiated in Benin with 25 groups. A Caisse Rurale d'Epargne et de Prêt/Rural Savings and Loan Funds (CREP)) brings farmers together with the first objective being to mobilize savings. As of March 1993, a total amount of nearly 7 million CFA (more than US$ 26,000) was put together by CREP members in Benin and 2,600,000 CFA (US$ 10,000) by farmers in Togo.

In the second phase, CREP will lend money to members.

The government of Benin has earmarked 4 million CFA to help the CREPs to improve their infrastructure and organization. The success of the CREPs can be important to farmers as they graduate from the PTP program. An efficient and less bureaucratic system of lending money could enable graduates to continue to apply their improved knowledge.

Recovery of PTP input loans in Benin has gone well to date (Table 6). The recovery rate in the PTP 1992 cycle will go above 85%. However, it will be risky to make any forecast in Togo; many farmers are hoarding their maize, not knowing what the future will bring.

Past experience teaches that farmers wait until June of the following year to pay their debt because the maize price is usually most

Table 6. Percent recovery of input loans in Benin and Togo.

Country	Region/ Department	1989	1990	1991	1992*
Benin	Atacora	100	98	93	80
	Atlantique	91	92	87	55
	Borgou	100	100	98	80
	Mono	100	95	90	67
	Oueme	100	83	82	52
	Zou	100	94	88	81
Mean		98,5	95	90	69
Togo	Maritime	-	100	100	44
	Plateaux	-	100	100	12
	Kara	-	91	99	37
Mean		-	97	99	31

* At the date of April 1993.

appropriate at that time. Financial institutions lending money to farmers should take that reality into account.

Achievements and Future Challenges

After nearly 5 years of demonstrating recommended technologies, several additional conclusions can be reached.

Cereal Production Should be Supported. There is an urgent need to support cereal production the same way cotton, groundnut, coffee, and cocoa are organized by host countries and external donors. SG 2000 and the Ministries of Rural Development have proven that the recommended technology is appropriate; yields can be dramatically increased; soils exhaustion can be reduced; and farmers' incomes can be significantly improved. Not only can farmers fill up their barns but they can sell their excess production.

Among other advantages of supporting new technology in cereal production: farmers get a new attitude; they want to fight for their own destiny and do not hesitate to get organized and pay their membership fees and social shares; and they mobilize savings to create their own loan associations. The enthusiasm is present and easy to feel.

CARDERs Have Changed Methods. In Benin, the impact of the SG 2000 program can be felt at the CARDER level. Extension staff realized that preaching to farmers without bringing them a hands-on package was nearly a waste of time. Some CARDERs decided to be more pragmatic and implemented demonstration plots similar to PTPs.

The SG 2000 approach to cereals production was recommended to implement the Rural Development Project of Atacora; technical officers were limited to supervise no more than 10 farmers in the project.

Fertilizers Are Important for Food Crops. Fertilizer used to be considered mainly for cash crops, namely cotton. Today, provisions for importing fertilizers also consider cereals' needs.

It now is accepted that maize must be fertilized in order to have high production. An application rate of 76-46-28 kg of NPK per hectare is accepted and no longer considered as excessive. As mentioned, recommendations may be fine tuned according to agroecological conditions in the future.

Production and Diversification Have Increased. Production has increased among SG 2000 farmers. Areas like Boukoumbe, Tanguieta, Materi, and Kobli in northern Benin were often hit by food shortages; the introduction of maize and the agronomic package helped those villages to record maize surpluses. Cotton areas like Banikoara in Borgou have discovered that maize can produce income equal or even superior to cotton income.

Officials and farmers appreciate the diversification program with cassava and mucuna. Many farmers sold mucuna seed to their neighbors as well as cuttings of improved cassava cultivars; their commitment was expressed in many villages.

They also like the payoff of the post-harvest technology. People in some villages, like Gbowime in Mono, agreed to finance and build their own cribs, store their excess production, and sell it in Cotonou for nearly 10,000 CFA per bag.

Some farmers complain that, as more farmers follow recommended practices, maize is abundant and market prices are low.

SG 2000 Farmers Receive Awards. SG 2000 farmers have received national awards for their excellence. The first National Farmer Day, held in 1992, was attended by the Head of State of Benin, who invited Dr. Borlaug to attend. Nearly 10% of the award winners were SG 2000 farmers. In 1993, even more SG 2000 farmers were among the winners.

Encouraged by PTP's results, many farmers asked that the project be extended to crops like yam, cowpeas, and groundnuts. Many farmers who are not SG 2000 participants are pressuring extension officers and even the minister of agriculture to have the program in their village.

Financial Institutions May Move Closer to Farmers. The establishment of savings and loan associations at the village level has convinced some financial institutions to move closer to farmers, instead of operating only from big cities or at the district level. Again, this potential expansion of credit availability is important in sustaining the use of the technology.

On a related note, farmers have learned and accepted the fact that they must graduate. Farmers realize the need to be independent and to look after their own needs.

Private Sector Involvement Needs to be Increased. The private sector needs to assume a larger share of agricultural activities. Fair prices should be given to farmers for their cash crops; the state monopoly on cash crops must stop. Another touchy point in francophone countries is the overvalued CFA, keeping agricultural products like maize from being competitive in world markets.

Government Still has a Policy Role to Play. Government also has a major role to play. Input procurement, fair producer prices, marketing channels, and credit all need improvement and attention in policy-making.

A technology has to be supported and bolstered by local institutions to bring a sustainable change into rural areas. Another major activity of SG 2000 is to interact with decision-makers and help them understand the need for strong and inspired support of agriculture.

The SG 2000 / CASIN workshop on "Policy Options for Agricultural Development in sub-Saharan Africa" held on August 1992 at Airlie House in Virginia (USA), gathered Ministers of agriculture, finance, and planning, as well as World Bank and other development assistance agencies and agricultural experts. It provided an opportunity to discuss many of Africa's challenges in technology transfer, extension, macroeconomic policies, food-price stabilization, rural financing, marketing, and structural adjustment programs.

Following the Airlie House meeting and reporting of results obtained in the PTP program, the Government of Benin earmarked more than $US 1 million (300 million CFA) to support small-scale producers. This move is a breakthrough. It takes such action to demonstrate that agriculture is the first priority.

Conclusion

SG 2000 experience in Benin and Togo continues to evolve. The project's methods need to be institutionalized to promote continued change. Extension services must become more efficient in transferring improved technology.

We should recognize that there are poor or marginal areas that offer little promise for success and we must put more effort on areas with greater chances of success.

The south of Benin and Togo are in critical condition in terms of sustainable agriculture. Soil protection and restoration are priorities. Cropping cereals after cereals must be stopped and farmers should include more legumes in their farming systems. The use of velvet bean to fight speargrass and restore soil fertility could be a breakthrough. Increased consumption of edible beans of mucuna will cause more farmers to grow them.

Post-harvest technology will receive more emphasis. Protecting crop products starts at the field level as most and crucial infestations occur before harvest. Building adequate and affordable storage structures will be essential.

A keystone to the process will be the fate of graduate farmers. A monitoring and evaluation unit will be needed to determine how are they are faring. It is only through graduate farmers that the sparks of green revolution can kindle success on the whole African continent.

Appendix 1

Maize Production Test Plots

Plot size:	5,000 m^2			
Variety, maturity, and color:	DMR-ESRW	:	90 days	white
	TZE-SR	:	90 days	white
	TZB-SR	:	120 days	white
Density:	80 cm x 40 cm 2 grains per hole			
Fertilizers:	NPKSB (14-23-14-5-1) 200 kg/ha Urea (46%) 100 kg/ha to total 74-46-28 kg/ha of NPK			
Time of application:	NPK to be applied no later than 15 days after planting. Urea to be pocket-applied and buried no later than 6 weeks after planting.			
Weeding:	Two are recommended. Combining weeding with fertilizer application is suggested.			
Harvest:	Harvest at maturity when silks are dry, husks are yellow, cobs are drooping, and finger nail cannot scratch the grain.			
Post-harvest:	Husk the corn Sort out and dry Treat with super actellic or sofagrain			

Appendix 2

Velvet bean for fighting speargrass and improving soil fertility

a) **Field partly invaded by speargrass**
Velvet bean can be intercropped with maize.

- Plant the bean 45 days after maize 80 cm x 80 cm with one grain per hill. (15,625 plants/ha) 15 kg/ha of seeds.

b) **Field completely invaded by speargrass (poor soils)**
Velvet bean is planted at high density in monocropping (improved fallow).

- Slash the field before planting. A second slashing of speargrass may be needed a month after germination.

- Plant the bean 80 cm x 40 cm with one grain per hill. 30 kg of seeds (31,250 plants/ha).

Appendix 3

Cassava

Cultivars:	AGRIC, BEN 86052 (Niaouli Station), TMs 30001, TMS 30572 (from IITA)
Planting time:	Cassava should be planted starting 15 days after maize planting and 30 days maximum.
Method:	Don't hurt cuttings. When cuttings are entirely buried they need to be short (15 cm) when they are partly thrusted in the soil (2/3) in a tilted position they can be long (20-20 cm).
Density:	Monocropping 10,000 plants/ha (1m x 1m) Intercropping 6,250 plants/ha (1,6 x 1)
Fertilizer:	Three 50 kg bags of KCl or K_2O (60%) (90 kg of K/ha)
Weeding:	Three weedings are needed; third to fourth week, seventh to ninth week, and twelfth to fourteenth week after planting.

N.B. Avoid using TMS 30001 on poor and degraded soils.

Appendix 4

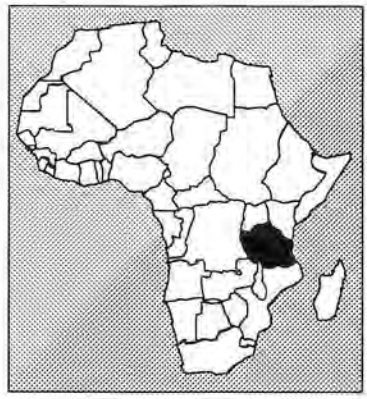
Improved Narrow Cribs

Hole depth	50 cm
Height from ground to floor	100 cm
Height from floor to the roof (rear)	200 cm - 170 cm
Height from floor to the roof (front)	230 cm - 200 cm
Rat guard	More than 75 cm from the ground
Width	70-80 cm
Ventilation	50%
Position to dominating wind	Perpendicular
Treatment	Quarterly
Operations	Husk the cob, sort out, clean the crib before filling. Use of local material is suggested.

Summary Report of the Sasakawa Global 2000 Project in Tanzania

Francis Idachaba, John Coulter, and Uma Lele*

The midterm review of the Kilimo-Sasakawa Global 2000 (SG 2000) project in Tanzania was carried out by a mission comprised of Francis Idachaba (agricultural economist and mission leader), John Coulter (agronomist) and Uma Lele (agricultural economist). Eija Pehu (FINNIDA) and Bekki Johnson (The Carter Center - Global 2000) served as resource persons.



The mission's brief was to review the project's progress; to define the policy, institutional, financial and technical conditions needed to ensure its long-term sustainability; and to suggest changes that could improve the project's effectiveness in helping Tanzania address its food security challenges.

The field work was carried out in Tanzania during May 31 to June 14, 1992.

The Setting: Agriculture in Tanzania

Tanzania has a low population density on average, but the road system is poor and population pressure already is severe in some of the more accessible areas. It is a poor country. Its economy is heavily dependent on agriculture, which accounts for about 40% of the gross domestic product, 85% of the exports, and more than 90% of the country's employment.

Tanzania has a great diversity of soils, climates, and vegetation with an equal diversity of agricultural opportunities. Major food crops are cereals, roots and tubers, legumes, and bananas/plantains.

Maize supplies more than 60% of total cereal production and — with an annual per capita consumption of around 100 kg — is an important part of the diet. Large areas, where rainfall is adequate, are planted to maize. Sorghum and other food crops are grown under less reliable rainfall conditions.

Reduced fallow, continuous cultivation, and an absence of crop rotations — dictated by farmers' needs to meet their household food requirements — result in low soil fertility and poor growth of crops. Grain yields increase greatly when plant nutrients are added.

Livestock comprise almost a quarter of the value of agricultural production in Tanzania, but large areas are infested with tse-tse fly, limiting animal numbers and particularly their use for animal traction.

Cropping systems vary from region to region, depending on population density, soils, and climate and farmers' resources, perceptions of risk, and market opportunities. Thus, maize may be grown as a sole crop or as a mixed

* Vice Chancellor, University of Agriculture, Nigeria; Former Scientific Advisor to the World Bank, United Kingdom; and Graduate Research Professor, University of Florida, USA, respectively.

crop, often with beans or other crops. Tanzanian farmers will change their cropping systems as they see new opportunities.

As in most African countries, women are an important part of the farm labor force. There usually are more off-farm employment opportunities for men than for women. Where men find off-farm employment, women usually are left responsible for organizing and managing the farming system.

Animal traction is available only in limited areas. Otherwise humans provide nearly all of the energy expended in both crop production and post-harvest work — including transport from field to village, processing at the village level, and transport to market. Women also are responsible for obtaining fuel, collecting water, and doing household work.

People's health affects agricultural production systems and the spread of malaria and AIDS profoundly affects agricultural output. Labor productivity must be increased to improve incomes and quality of life, particularly for women farmers. This emphasizes the necessity, not only to improve the efficiency of human energy by improving health, but also to use more of other forms of energy in the agricultural production systems. These include animal traction and chemical and mechanical energy; they could help address the international concern for helping women farmers.

In spite of these problems, Tanzania has the potential to increase its food- and export-crop production, to be self-sufficient in food production, and to export maize to neighboring countries.

An Overview of the SG 2000 Project

The SG 2000 project — primarily funded by the Sasakawa Foundation with supplementary assistance from the Government of Finland (FINNIDA) in 1990 and 1991 — was started in 1989 and had an operating budget of about US $1 million per year during 1992 and 1993.

Its major objective is to introduce modern agriculture to cereal growers through the use of fertilizers, improved varieties, and improved agronomic practices. Smaller areas of sorghum and wheat are included in the project. The project is predicated on the understanding that there is sufficient proven technology to increase crop yields, that it can be used by small farmers, and that it will be improve their productivity and their incomes.

The SG 2000 project assumes that the green revolution approach, so successful in Asia, can be adapted to African conditions.

Tanzania provides more challenges that did India and Pakistan, which had abundant trained manpower and a political commitment to implement an agricultural strategy for developing smallholder agriculture. In addition, the transport and communications networks were good in India and Pakistan, whereas they are weak in Tanzania.

However, Tanzania has undertaken major policy reforms since 1986. Projects such as SG 2000 have an opportunity to make these reforms more effective and have a greater impact.

The SG 2000 project collaborates closely with the Ministry of Agriculture, Livestock Development and Cooperatives. The ministry's regional and district officers play key roles in implementing the project, particularly in selecting locations of project sites and farmers within villages. They supervise their field staff who are involved in project activities. Practical

and classroom training of the extension staff — particularly village extension workers — is important in strengthening the linkages among researchers, extensionists, input distributors, credit vendors, and small farmers.

While concentrating on important regions where maize, sorghum, and wheat are grown, accessibility influences the selection of villages. Following the training of extension workers from selected villages, 10 farmers from each of those villages are chosen to participate in the first year of the project. More farmers are added in the second and third years, or cycles, of the project so that, by the time the village graduates (completes its participation in the project), 50 or more farmers may have taken part.

These farmers, as well as their neighbors who have observed the technology and its results, are expected to continue using the new practices until the majority of farmers are using this production system. This process provides the important multiplier effect.

The key technical input is the large management training plot (MTP). It covers one acre, in contrast to most demonstration plots, which are usually 1/20 acre or less. A standard fertilizer package for each crop is used throughout the country. Improved seed, including both open-pollinated and hybrid varieties of maize, and standard agronomic practices of spacing, line planting, insecticide treatment, and weeding are used.

The large plots have several advantages over the small plots used in conventional demonstration trials: they let farmers realistically assess the labor needed for the improved technology and they emphasize the need to apply the right inputs at the right time. Therefore, they show not only farmers, but policy-makers, administrators, and private sector suppliers, the potential and the needs of improved technology.

The SG 2000 Project's Achievements in Tanzania

In 1990-91, about 8,900 maize MTPs were planted in 280 villages in six regions and about 650 sorghum MTPs also were planted. The MTPs showed that maize yields could be increased from the traditional average of about 1.5 tons/ha to more than 4 tons/ha, with some farmers reaching 8-9 tons/ha.

The review mission's visits to many villages showed the uniformity of the maize crop and the high yields of the MTPs. Symptoms of nutrient deficiencies in nearby fields, where traditional practices were used, confirmed the generally low fertility of the soils.

These visits also confirmed the high quality of the agronomy in the MTPs and the farmers' enthusiasm for the program, which they perceived as providing increased purchasing power and incomes for their children's education. The mission also found strong political support for the program.

The village level extension workers are strongly motivated by having something tangible to offer farmers, by having transport available, and by recognizing their important role in improving agriculture.

Farmers in the villages were found to be surprisingly knowledgeable about the use of fertilizers and improved seeds, partly from their experience with the World Bank-supported National Maize Project in the 1970s, and partly due to their high literacy rate. They appeared convinced (1) that improved agronomic practices, without fertilizer inputs, had little long-term impact on yields and (2) that they were successful because the program ensured the delivery of inputs and showed them how to combine the components of improved production in an optimum manner.

Loan repayments in the first 2 years of the project are reported to have been good, except where drought intervened. It was clear to the mission that the project avoided some of the problems that occurred elsewhere by not expanding too quickly and by limiting the MTP's to a manageable number.

Opportunities and Needs for Future Development

The project has a strong learning-by-doing approach, a high-quality staff, and a flexible approach, which allows it to be innovative and to react quickly to lessons learned in following up on new opportunities. In this context, the mission identified some technical, management, institutional, and policy issues that need attention over the short and medium term.

Some Technological Issues Need Consideration. Major criticisms of the project are that it (1) promotes a high-input system that encourages monocropping with maize, (2) depends on large dressings of chemical fertilizers that may damage the environment, and (3) is profitable only for larger and better-off farmers. Some of these arguments are reinforced by the facts that Tanzania is a land-abundant country and that fertilizers cost scarce foreign exchange.

In considering these criticisms, one must bear in mind that (1) farmers already practice monocropping, (2) monocropping has advantages in crop management, particularly in controlling weeds, and (3) individual farmers make their own choices about cropping patterns depending on their availability of labor and land, market opportunities, and their perceptions of risk.

Chemical fertilizers are criticized on three counts: (1) that they pollute the environment; (2) that agricultural systems based on fertilizers are unsustainable in the long term; and (3) that their cost precludes their use by small farmers.

Under farming conditions in Tanzania, the first two criticisms are not correct. The present farming systems, which essentially mine the soil of its nutrients, certainly are not sustainable in the long term.

Further, improving soil fertility benefits all crops, whether grown for sale, for household use, or as part of a mixed-crop system. The residual effects of improving soil fertility widens the opportunities for farmers to diversify their cropping systems and to develop new and more-profitable crop combinations.

The cost of fertilizers is, obviously, a serious issue. Farm productivity is highly sensitive to yields and input and output prices. Another factor to be considered is the long-term benefits of fertilizers in building up soil fertility to counteract the soil nutrient mining that is taking place under the present farming systems.

The mission's discussions with small and large farmers indicated that it was the lack of availability of the right inputs at the right time that was the major constraint. The farmers are seriously concerned about the supply of inputs when SG 2000 finally withdraws.

Low-input systems, sometimes advocated as an alternative to the fertilizer/improved seed approach, are designed to increase productivity using organic fertilizers, crop rotations, and intensified agronomic practices. Where there are opportunities to use these practices, they can complement the use of purchased inputs. But there are major difficulties in the widespread use of this approach:

- Animal manures are not available in many areas and, where they are, the nutrient levels are low, particulary in phosphate, because of the poor quality of the native pastures.

- Making compost requires that water be readily availabile. It isn't in many areas.
- If animal-drawn transport is not available, all forms of organic manure application require a large labor input. For example, transporting 5 tons of compost from the village to a field 1 km distant would require the equivalent of 25 days of labor for head-loading.
- Improved agronomic practices, without additional inputs, may temporarily give somewhat higher yields, but they lead to even more efficient soil nutrient mining.

Mission members believe, therefore, that the fertilizer/improved seeds technology must play an increasingly important role in improving agricultural output in Tanzania. In the absence of such inputs, soil conditions will continue to deteriorate, pressures on forest lands and on the fragile areas presently used for grazing will increase, and labor productivity will fall. The decline in labor productivity is particularly important because of the crucial role of women in the farming system.

An important technological issue for the future, therefore, is refining fertilizer recommendations for different farming systems and for farmers with differing levels of resources so that they will be more efficient and cost-effective. The fertilizer recommendations must take account of the farming system, the previous crop, the soil type, phosphorous status, and the risks due to erratic rainfall.

In some circumstances, the optimum fertilizer level will be less than the present common recommendation. In others, farmers may decide to use higher levels. In the risk-prone, low-rainfall areas where sorghum is a major crop, a small dressing of phosphate fertilizers may be the most appropriate. Phosphate fertilizers have an important year-to-year residual effect and it has been demonstrated that they enable crops such as sorghum to make more efficient use of limited rainfall.

The mission recognizes that a common recommendation was needed to start off the program; it considers that there is now enough experience and information to start refining the fertilizer recommendations to reduce costs and use scarce resources more efficiently.

SG 2000 Should Avoid Overextension.
By comparison with many other development projects, the SG-2000 project in Tanzania is quite small, with limited financial and management resources. Therefore, it has to consider carefully its alternatives in using these resources and to avoid being drawn into more activities than it can effectively handle.

Clearly, agricultural development in Tanzania is highly complex and there are almost as many approaches as there are donors. While a variety of donor approaches present problems for the country, they also present opportunities to choose those that work.

Important items on the agendas of one or more donors are soil conservation, agroforestry, development of cash crops such as vegetables and fruits, improving the lot of farmers in the low-potential zones, and the needs of women farmers. SG 2000 cannot be involved in all of them, though it is well aware that they are important. It has, quite rightly in the view of the mission, focused on a few commodities and has not attempted to deal with all the constraints that the farmers face.

The mission therefore considers that the project's important management issues relate to: selection of farmers, and particularly to ensure that women farmers are appropriately represented; selection of commodities; graduation of villagers from the project; and the extent to which the project can influence the national strategy on food security to ensure the sustainability of its work.

Selection of farmers starts with those who are more accessible and prominent. This leads to bias in selection. This is particularly true for women farmers. About 20% to 25% of the project's participants are women. They are enthusiastic and diligent in repaying their loans. In view of their importance in agriculture, the project will continue to improve women's representation. This goal will require particular attention to inputs, especially credit, and to tailoring the approach of the extension agents to women.

The project's success has stimulated farmers to request that it be extended to other crops (beans), other commodities (fuelwood), and other factors (animal traction). It is clear that farmers understand and articulate well what they need to modernize Tanzania's agriculture. An important question is how well the government will respond to these other needs by playing a facilitating, rather than a controlling, role

Again, the project's limited resources in terms of money and management staff time means that SG 2000 must consider any expansion carefully, particularly as it is already moving into the post-harvest and animal-traction fields.

SG 2000 should be able to attract other donors to use the project's model in other commodities and factors; the development of fuelwood would ease the labor burdens on women and improved technology for bean production would alleviate hunger.

Another management issue to be confronted is what happens to farmers after graduation. While MTPs are demonstrated in a particular village for 3 years, only a few villagers will have had the full benefit of the MPT experience over all 3 years. The greater proportion will only have benefited for 1 or, at most, 2 years.

Collectively, the farmers and the village extension worker will have absorbed most of the technical information but the major problem confronting them after graduation will be the availability of inputs — credit, fertilizers, and seeds. In the absence of these, the farmers may be forced to return to their traditional low-input, low-output system.

The mission emphasizes that ways must be found to manage the transition from program-organized inputs to commercial-sector-provided inputs, so that graduation does not result in a breakdown of the program. This may involve a phased withdrawal, but the right transition cannot be predicted until the commercial sector has operated over a trial period.

Finally, a systematic assessment of the program's impact and potential through a household- and farm-survey-based evaluation would add greatly to the value of the anecdotal and impressionistic evidence accumulated during the field visits. Such an evaluation would explore the financial and economic profitability of the SG 2000 program, examine the impact of other extension methods, and provide a sounder basis for policies related to input and output pricing and subsidies.

Institutional Issues Need Consideration. The World Bank-supported training and visit (T&V) system and the SG 2000 program have similar long-term objectives — to promote the modernization of agriculture and to improve farmers' income and food security at both the household and national level.

The T&V system of extension is predicated on the assumption that improved agronomic practices alone will have a substantial payoff without additional modern inputs. This approach assumes that the farmer, given better advice, will be able to use his existing land and

labor resources more productively. However, the mission observed, from conversations with farmers, that the return to changed agronomic practices is relatively small without the inputs of fertilizer and improved seeds, which the SG 2000 approach included.

The government needs to determine how these two systems can best operate together.

Another difference between the SG 2000 approach and others is that the project uses one-acre plots as compared with other trials of about 10 m by 10 m. The latter serves as a small demonstration, but does not give farmers the experience of procuring and managing the inputs and outputs — and the labor demands — of a commercial-sized operation.

An important institutional issue is the private sector's role in supplying inputs and providing markets; without these the project's approach is not sustainable on a long-term basis. Increased inputs are essential to intensification, but they have to be organized and delivered in a country with poorly managed input delivery systems and a poor road system; only 10% of the rural roads are passable year round.

Thus, ways must be found for enabling the emerging private sector to play an increasingly important role in fertilizer procurement, distribution, and marketing. However, experience from countries the world over shows that, without competition among public sector entities, exclusive reliance on a weak private sector is unlikely to intensify agriculture.

There are other major problems concerning the whole question of fertilizer supplies. Year-to-year variability in both the type and amounts of fertilizer that are available to farmers is a major handicap in planning a fertilizer strategy. This is because the Government of Tanzania has relied heavily on donors for the commodity and, consequently, the supplies are erratic and the formulation is determined by the availability of particular compounds or single-nutrient products in the donor countries.

There are major problems, too, with seed production and supplies. In 1989, when SG 2000 started, only 10% of the maize area was planted to improved seed. This compares with 95% in Zimbabwe and 55% in Kenya.

The recent entry of the Cargill Seed Company into northern Tanzania is promising, but its efforts are still modest. In the southern highlands — so important for the country's maize production — farmers still depend on the uneven quality of seed from Tanseed or on higher quality, but more difficult to obtain, seed from Kenya and Malawi.

Farmers also are worried about problems of marketing their produce. They report that traders tried to cheat on weights and that transport bottlenecks prevented the movement of grain to markets at times. They also reported that the maize prices they received were substantially lower than those assumed in the SG 2000 farm budgets. This highlights the need for farm survey data to clarify the profitability of maize production.

Economic Factors Affect Future Progress. Tanzania has had a long history of subsidized fertilizer sales and government-controlled purchase of grain. Now fertilizer subsidies are being gradually eliminated and the private sector is entirely responsible for marketing.

In the absence of fertilizer subsidies, the profitability of the present package recommended by SG 2000 changes. A sensitivity analysis — assuming more realistic input and output prices than those presently used by SG 2000 — shows that use of unsubsidized fertilizer is unlikely to be economically attractive.

This fact is particularly important in view of the regular currency devaluations that raise input costs without benefiting output prices. Benefit-cost ratios exceeding two usually are considered necessary to ensure farmer interest but, again, they can be obtained only with a subsidy.

The issue is exacerbated by the large seasonal fluctuations in grain prices. For example, in the past season they varied from Tsh 2,000 per bag at harvest to Tsh 5,000 before the following harvest. This suggests that improved farm storage (already under trial by the project) could make an important contribution to farmers' incomes.

Government Needs to Consider Policy Issues. It is clear from the discussions of the technological, management, institutional, and economic issues that the government must make important policy decisions if agricultural development programs are to succeed. Thus, our analyses of policy issues leads us to conclude that, while macro-adjustment is essential in the long run, in the short run it has accentuated institutional and policy problems that have long existed in Tanzania.

This is due partly to the lack of an agricultural sector strategy and partly to the slow reform of agricultural policies. To overcome these problems, the government needs to

- develop a policy for the import and distribution of fertilizers and other chemical inputs
- develop a policy on national seed production and distribution
- develop policies on food security, agricultural extension, input and output pricing, agricultural credit, and the role of incentive goods
- increase traders' access to credit in order to strengthen their input-distribution and output-marketing operations

Developing coherent policies is difficult for the country because donors have a large input and, hence, influence. There are many contentious issues on which donors hold widely different views, but which require a generally agreed-upon strategy on food production. Donor policies need to be complementary with each other and with those of the country.

Tanzania requires strong institutions for agricultural development to succeed. There is a pressing need, therefore, for donors to combine their efforts in institution building, including the training of Tanzanian policy-makers to cope with the major changes that are under way.

Such combined efforts also will be needed in improving the country's physical infrastructure, especially the rural feeder roads to improve market integration. Local governments' capacities to build and maintain such roads needs to be strengthened.

The mission is convinced that Tanzania has substantial opportunities to improve the productivity of its agricultural and rural sector and that, given the correct policies, the SG 2000 program can increase its contribution to that improvement.

Contribution of the Sasakawa Global 2000 Project to Tanzania's Agriculture

Honorable Jackson Makweta, MP*

On behalf of the Government of Tanzania, I wish to express our appreciation for the presence at this workshop of former President of the United States of America, Mr. Jimmy Carter; President of Sasakawa Africa Association, Dr. Norman Borlaug; and Mr. Koichi Takagi, representing the President of the Sasakawa Foundation, Mr. Yohei Sasakawa.

We have been jointly involved with these distinguished gentlemen in implementing the Kilimo-Sasakawa Global 2000 (SG 2000) project in Tanzania through actively collaborating with their in-country staff. We highly commend the staff for their good work and especially express our appreciation to Dr. Quiñones for his contribution during his assignment in Tanzania.

Tanzanian Agriculture in Perspective

In order to appreciate the contribution of the SG 2000 project to our country, it is necessary to gain a perspective of Tanzanian agriculture.

Agriculture provides more than 90% of employment opportunities for adults of working age. Out of a population of 23.2 million, 80% live in rural areas. The population density of 26 persons per square kilometer is low. Therefore, land is easily available for farming except in limited preferred areas near Mount Kilimanjaro in the northern highlands. Here the traditional land tenure system is dominant and land is continuously being subdivided among family members.

Agriculture has made and continues to make major contributions to Tanzania's national economy. Approximately 45% of our country's gross domestic production (GDP) is contributed by agriculture. The GDP index shows that, over the past 20 years, agriculture's contributions to the national economy have compared favorably with those of industry and services.

Generating additional income in rural households is the most effective way of alleviating hunger and poverty in my country and, perhaps, in the rest of Africa. The prospects of reducing hunger and poverty in Tanzania in the short-term are good, due to the tremendous potential of our unexploited national resources.

These resources include a land area of approximately one million square kilometers, of which 45% is arable. Only 16% of this arable land is cultivated. Our climate variation provides unusual opportunities to grow temperate, subtropical, and tropical plant and animal products.

* Minister for Agriculture, Ministry of Agriculture, Livestok Development and Cooperatives, The United Republic of Tanzania

Tanzania has reduced its budgetary allocations to the agricultural sector. Because of these reductions in the national investment in agriculture, we have cut imports of agricultural inputs (such as fertilizer, agro-chemicals, and farm machinery).

These reductions were caused by the redirection of more than 50% of the nation's foreign exchange earnings to buy fuel immediately after the oil price hike of 1973. Since then, we have depended on fertilizer donations from concerned donor countries.

However, in 1992, this direct assistance was reduced when provision of fertilizers was linked to an Open General Licence (OGL) purchasing system as part of the Sectorial Economic Recovery Program. A significant reduction of the input subsidy was required in return for financial support for the OGL system.

Tanzania's Experience With SG 2000

In Tanzania, attaining national food self sufficiency and, subsequently, producing surpluses for export, is the centerpiece of our National Agricultural Development Policy. Therefore, we appreciate the efforts of SG 2000 to support small-scale farmers by introducing appropriate technologies to increase their farm productivity.

The Government of Tanzania, through its Ministry of Agriculture, is committed to sustaining the beneficial achievements of the SG 2000 project. This will demand our continued commitment of staff and resources to maintain an effective extension mechanism with efficiency equal to that achieved under the project's international staff.

Our experience with the SG 2000 agricultural project has helped us to realize a significant part of our aspiration of increasing food production. It also has demonstrated successfully the potential contribution of small-scale producers and stockists as private entrepreneurs in a more-developed agricultural production system. These initial results have heightened our expectations for realizing our agricultural development aspirations.

The Government of Tanzania continues to share common and fundamental development goals with the project, including (1) emphasizing food crop production, (2) modernizing agriculture through the transfer of improved production technologies, and (3) strengthening capacities of the institutions serving agriculture — namely extension, research, and marketing and input-supply institutions.

The SG 2000 project strengthened Tanzania's agriculture and institutions through pursuing those three main goals in the following ways:

- It has strengthened the extension service's capability to disseminate information and increased the effective coordination between research and extension in delivering new technology to small-scale farmers.
- It has demonstrated ways to increase small-scale farmers' productivity and raised their expectations of how much their farming systems can produce.
- It has enhanced market demand for the components of improved agriculture thereby stimulating the growth of an increasingly privatized input-delivery and marketing system at the village level.

Details of the SG 2000 accomplishments are elaborated in the country program report submitted by the mission members who reviewed the project. (These reports immediately precede this one.) However, a

few examples merit mention because of our appreciation of them:

- A total of 437 extension workers and 32,691 farmers have received practical training in production techniques associated with farming systems for maize, sorghum, and wheat cultivation.
- A total of 33,071 management training plots have been implemented in 28 districts, among which 443 villages participated in the project's field agronomy training scheme.
- So far, a total of seven regions out of 20 have been involved directly in project implementation. Some districts in an additional three regions have been involved through collaborative efforts between the government, SG 2000, and other donors.
- Through the project's postharvest and farm implement training programs, many farmers have gained skills and access to these technologies on their own doorsteps and are showing and teaching them to other farmers. These techniques are being demonstrated at the regional and national agricultural shows, which are in progress.
- Small-scale farmers in project areas are adopting aspects of improved production systems. Even farmers from regions that have not been included in the project have shown considerable interest in the recommended production technologies.
- The project has increased the interaction between extensionists and researchers.

Challenges for the Future

We are fully aware of the limitations imposed on us by our lack of financial resources. Furthermore, limitations in other sectors, such as transportation facilities — particularly the need for construction of feeder roads — are still unsolved in spite of our determined efforts.

We, therefore, are happy to note that SG 2000 is welcoming opportunities to work with other donors in partnership with the Government of Tanzania. We are convinced that the magnitude of the task ahead for agricultural development in Tanzania and elsewhere in Africa will require a bold gesture of assistance proportional to that received by Western Europe in the form of the Marshall Plan after World War II.

In the interim we can work together towards systematically alleviating the most pressing bottlenecks in our food production systems.

More needs to be said about the procurement and availability of fertilizers at the village level. We consider that, after water, its insufficiency is the biggest constraint to increasing agricultural production in Tanzania.

Current fertilizer imports meet only 39% of the projected national demand. In 1991, only 136,510 metric tons were imported out of a projected demand of 350,172 metric tons. This shortfall of 61% is likely to persist and may even get worse because of budgetary constraints; Tanzania cannot sustain the purchases of fertilizers required for projected increases in food demand.

This suggests that the Government of Tanzania needs to devise a comprehensive policy for procuring agricultural inputs. The government has proposed establishing a national fertilizer revolving fund to facilitate timely purchases of fertilizer. Details of its operation and accounting systems will be available to donors who wish to make cash or in-kind contributions.

One of the important lessons we as a government have learned from the project is to focus our attention on overcoming a few key constraints to progress at a time. The significance of this experience for current

policy is to clearly recognize the limitations to our agricultural development and the need

- to plan and provide for fertilizers as an essential and major component of our strategy for increasing food production
- to ensure a favorable climate for the establishment and growth of an efficient input-delivery and marketing system
- to increase the effectiveness of professional agricultural workers and to build their capacity to accomplish technology innovation and dissemination

Commitment to Actions for Sustainability

Project sustainability has emerged as the new buzz word in development circles. However, when we examine national demand in relation to budget capacities and see the additional opportunities for expanding agricultural productivity we come face to face with the continuing challenges in this changing world.

The Government of Tanzania remains committed to developing its working partnership with SG 2000 and other donor agencies and governments. We sincerely hope that, with your support, we will make progress in our combined efforts to alleviate poverty and hunger among our most needy people.

Comments on the Sasakawa Global 2000 Project in Tanzania

A.M. Foster, D.T. Akibo-Betts, and A. Mtui

We are grateful to the Government of Tanzania for hosting the Kilimo-Sasakawa Global 2000 (SG 2000) project and assisting it in many ways, especially with its human resources, without which it would be impossible to implement an endeavor of this nature. We are grateful to many other persons and entities.

Thousands of farmers eagerly and tirelessly participate in the program's field and training activities. They have our special gratitude and we extend this gratitude to Dr. M. Quiñones, former country director, for helping transform the country's agronomic practices to increase food production and preservation.

The commissioner for agricultural extension supports the project by participating in coordination meetings and facilitating the institutionalization of the project approach.

Government officials at the regional and district levels instill a sense of responsibility for development among farmers and village leaders.

His Excellency, President Ali Hassan Mwinyi; the Honorable Prime Minister, Mr. John Malecela; and the Honorable Minister for Agriculture, Mr. Jackson Makweta encourage farmers, the Kilimo and SG 2000 staff, and project collaborators when they tour project areas. This sensitizes the people of Tanzania to the project's importance in developing the nation's agriculture.

Sasakawa Africa Association (SAA) President Dr. Norman Borlaug inspires and guides the project staff, not only within Tanzania but elsewhere in Africa.

Overview of the SG 2000 Project

The SG 2000 project aims to develop small-scale farming in selected African countries by facilitating the widespread adoption of improved agronomic practices by small-scale farmers.

The project uses management training plots (MTPs) as the principal extension tool for exchanging and transferring information to farmers on the improved agronomic practices. The idea is that increasing grain yields per unit of area is a more profitable and environmentally sustainable way to increase farmer productivity than increasing production by farming more extensively and encroaching on fragile lands.

Thus, we have chosen intermediate- to high-yielding production environments as project sites. We assume that surplus production in these areas will flow through formal and

* SG 2000 Acting Country Director, Senior Agronomist, and MALDC National Coordinator, respectively.

informal grain-marketing channels to less well-endowed areas within the country and, possibly, to markets in neighboring countries.

Since it began in 1989, the project has emphasized improving field agronomy through demonstration and training activities. We base production recommendations on existing technologies that are available for maize and sorghum farming systems.

Farmers are grouped in clusters of about 10 MTPs per village. Trained extensionists give farmers information about improved food-crop production practices and demonstrate the skills the farmers need to apply the practices.

The number of MTPs was increased between the second and third cropping cycles to achieve a rapid, but controlled, dissemination of extension messages. The number then was reduced when the project began developing complementary components, including using animal draft power and reducing post-harvest quality and quantity losses.

Zonal Research Centers Provide Backstopping. Researchers at farming systems research (FSR) units in different zones developed collaborative activities to provide technical support (backstopping) for the MTP production recommendations and improve their economic and environmental sustainability. These complementary on-farm research activities are carried out by the research staffs at the Selian Agricultural Research Center (in Arusha) and Uyole Center for Agriculture (in Mbeya).

Examples of second-generation production recommendations developed at SARI are cereal and grain legume intercropping systems for maize-bean and maize-pigeon pea cultivation. These cropping patterns are being demonstrated at five MTPs per village in Arumeru and Babati districts that have completed two crop cycles of first generation demonstrations.

Promoting Greater Use of Animal Traction. Profits from MTPs sometimes permit farmers to invest in draft animals, which lets farmers increase their production per unit of labor and reduce their labor cost per unit of production. Further, if farmers learn how to use ox implements for a wider range of farm operations, the demand for women's labor may be reduced.

However, the use of ox implements is limited by a lack of trained animals and handlers. Many farmers who have oxen and implements frequently use them for land preparation, seldom for planting, and almost never for weeding.

Consequently, the need to train farmers to use ox implements evolved as a complementary aspect of the field agronomy program in areas where animal traction is available. With the exception of limited areas in the northern highlands, land is readily available to farmers, particularly in areas where oxen are prevalent.

A Postharvest Program Was Added. A postharvest program was introduced early in 1992 to enhance food security at the farm homestead. Following a field and household survey to identify the most important causes of losses in grain quantity and quality, a package of practices was formulated to alleviate the problems. The resulting package included

- introducing improved handling and storage equipment, including structures such as 3 m x 4 m cemented drying floors, 2-ton capacity cement-coated silos, and a hand sheller for maize
- training extension workers on the principles of grain handling and crop hygiene so the new equipment and structures would be used properly

The cost of the equipment for handling and storage, including the drying floor, was the price of three bags of cement, one kilogram of nails, and a hand sheller imported from Ghana — a total of Tsh 10,000 (US$ 28.50).

The first training scheme started with five farmers in each of ten villages per district in Iringa, Mbeya, and Rukwa regions. Village extension workers (VEWs) were trained on a regional basis. They were taught the carpentry and masonry skills needed to construct the drying floors and silo, which was a cemented kihenge (twig basket).

After the training sessions, each VEW was supplied with enough material to build one of each of the structures within his village. Staff then judged the structures to evaluate the effectiveness of the training. Structures constructed in Iringa region showed the most skilled work.

Following the recommendation that training activities be conducted for the southern and northern zones, Iringa was selected as the training center for the southern highlands and the Arusha region was to service the northern highlands.

Project Results and Achievements

The review of the project's results and achievements show where advances have been made. Following is a report of various aspects of the project, the number of farmers who were directly and indirectly involved, and suggestions as to how Tanzania can consolidate elements that are keys to sustaining the benefits of the project's achievements.

Many Thousands of Farmers Have Been Reached. A total of 33,071 MTPs have been implemented to date. These one-acre plots have served as demonstration and training sites for the direct participants and neighboring farmers. Assuming a multiplier effect of 10 farmers per site, more than 300,000 farmers probably have been influenced by the extension messages embodied in the MTP approach.

We estimate that about 25% of the farmers reached were women, based on the ratios of men and women who attended field days and training sessions. However, not all of these would be heads of households. A goal is to increase the number of women farmers participating in the project by building in activities that focus on their farms. We also will assist women professionals in agriculture to promote programs that encourage women to participate at the village level.

The extension network implementing the program has involved 437 resident frontline staff in the 443 villages and 28 districts. Extension messages have been transmitted to target groups through field days, extensionists' visits to farm homesteads, exchange visits among farmers, and mass media, namely radio and newspapers.

Initial results of a survey conducted among farmers who had to buy their own farm inputs after completing three consecutive cycles of the MTP program indicate that the extension messages encouraged widespread adoption of improved crop production practices. Approximately 30% of respondents within the project area attributed their use of fertilizer to MTP extension exercises. (Nkonya et al. 1992.)

In order of importance, these farmers gave priority to the following practices: applying nitrogen fertilizer; increasing plant population; planting at the right time; and controlling weeds. Access to inputs at the village level and on credit were major factors influencing farmers' decisions to use fertilizers and insecticides; this supports the view that both information and production inputs are needed for farmers to accept new production-increasing practices.

The indirect influence of MTP-related extension worker visits to homesteads could not be separated from traditional extension activities; farmers correctly viewed the two as being the same information source.

Farmer-to-farmer interaction, including field days and exchange visits between farmers, was found to be the dominant source of information concerning MTP production technologies.

Yields Increased as Much as Fourfold. Farmers using the SG 2000 improved technology increased their yields of maize, sorghum, or wheat — depending on which they grew — by up to four times those obtained by farmers using conventional production practices.

In most regions that produce maize, more than 50% of the MTP farmers doubled their yield. A small proportion of them obtained grain yields in the range of 5 to 7 tons/ha. By contrast, most farmers using traditional production practices obtained grain yields of less than 2 t/ha, only a few obtained yield levels in the range of 2 to 3 t/ha, and none obtained grain yield levels above 3 t/ha.

Farmers Are Taught Efficient Cultivation. As mentioned earlier, the objective of the farm implement training scheme is to teach farmers more labor-efficient methods of cultivation. Another is to provide farmers limited access to labor-saving tools that will help them escape the drudgery of cultivating with a hoe.

Observations during a trial period of oxen-drawn implement training indicated that a family of five — including two adults and one teenager — could cultivate 3 to 5 acres if land preparation, planting, and weeding were done with oxen, compared to only 1 to 2 acres if done with a hand hoe.

In the northern highlands, ox implements have been placed in more than 40 villages and 120 farmers have been trained. The equipment selection will let farmers see different implements, learn what they do, compare their prices, and evaluate how they fit their particular farming operations.

In the southern highlands, 30 extensionists have completed an intensive short course in ox implement use at the Mbeya oxenization center and will be ready to train village farmers in the 1993-94 crop cycle. The combination of equipment is designed to give extension workers a wide range of skills and gain experience in assembling, maintaining, and using animal-drawn equipment.

Postharvest Technology Helps Protect Food. The postharvest program, described earlier, was started early in 1992 to preserve the increased food quantity and quality resulting from the SG 2000 technologies.

A total of 25 silos and 40 drying floors have been constructed in training activities involving extensionists from four regions. A total of 150 hand shellers have been distributed and are being used in as many homesteads.

While farmers are responding positively to the postharvest technologies, dissemination is limited by the speed with which extensionists and farmers can learn to weave baskets and acquire the carpentry and masonry skills required to construct the storage silo and drying floor. Another holdup is that twigs for weaving baskets for silos are available only at certain seasons of the year and this limits the number of baskets farmers can weave and when they can weave them.

Also, transferring the technology is not simple. Failure to follow the recommended technology may result in significant losses of grain quantity or quality over time, due, for example,

to seed germination and fungal growth because of improper orientation of the structures or insufficient roof cover over the silos.

Institutional Linkages Are Strengthened. The increased demand for fertilizer and improved seed — and the intensive extension activity in transferring technology — during the first three cycles of MTPs provided an opportunity to establish commercial systems for procuring and distributing inputs by stockists and farmers associations at the district and village level.

Since government liberalization policies permitted stockists to sell inputs, many individuals have capitalized on the demand for fertilizer and seed. In Arusha region, more than 60 stockists sell farm inputs. There are many stockists in the southern highlands. The project indirectly supports these stockists by channeling input purchases through them and by reducing the input-support loans to farmers to the minimum needed for training in new areas.

TechnoServe, in conjunction with SG 2000, started farmer-managed input-procurement and produce-marketing systems that could be sustained by small-scale farmers. Managing farmers associations proved to be far more labor intensive than managing a stockist's shop. So far, four of six initial farmers associations are financially solvent after two crop seasons.

However there are signs that, in areas where farmers have a tradition of village-level credit and savings schemes, they can easily form their own growers associations without financial assistance and with minimal guidance on procedural issues. Farmers in the Kilimanjaro region are pursuing this avenue of developing an input-delivery system. Thus, there are new opportunities for TechnoServe to help empower farmers' groups without loan guarantees from SG 2000.

There are many problems in making fertilizer available to farmers when it is needed. Typically, delays in fertilizer deliveries from the national level to regional capitals last year result in carryover stocks this year. Stockists have limited working capital and cannot afford to finance carryover stocks.

Another problem is lack of funds for procuring fertilizers at the national level. Ways must be found to increase the efficiency of the national fertilizer procurement system; that is the greatest challenge to Tanzania's agricultural advancement — and for sustaining project achievements.

The government has adopted economic policies to reorient agricultural development towards the private sector. However, the private sector has not developed fast enough to meet the already established national demand for fertilizer and seeds. Seeds are produced locally and therefore do not present as big a problem as fertilizer.

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The Sasakawa Global 2000 Project in Sudan in Perspective

Musa Mohamed Musa*

It is my great pleasure to address this distinguished forum, organized by SAA/SG 2000/CASIN, on behalf of His Excellency Minister of Agriculture, Natural and Animal Resources, Professor Ahmed A. Genief, whose commitments prevented his participation.

He strongly feels that such high-level interaction can go a long way towards alleviating many of the obstacles and hazards facing many sub-Saharan African countries.

He also believes that the outcome of the workshop that he shared in Arusha in 1991 formed a basis for cooperation and partnership in enhancing the sustainability of African agriculture in general and of food production in particular. Sudan is gratified to participate and to share ideas, successes, and new perspectives.

This meeting has a special flavor for us because Sudan was a pioneer member country in sharing the benefits of cooperation with SG 2000 activities in Africa as far back as 1986.

Since then, SG 2000 staff, cooperating research scientists, extension staff, parastatal organizations, and farmers — helped by a national steering committee — have acted as a closely knit family. We are proud to say that this greatly helped Sudan shape and consolidate the success in food production it has attained, especially pronounced in the past two seasons — 1991-92 and 1992-93.

This meeting also has a special flavor now that our agricultural development strategies are more clearly spelled out than they were previously. Therefore, I would like to discuss some new linkages with SG 2000 for consolidating already-attained results and for developing new initiatives. That the project in Sudan slowed down in the 1991-92 season and was discontinued since April 1992, due to shortage of funding, should not jeopardize future cooperation.

Sudan Depends on Agriculture for Growth

Sudan is the biggest country in Africa with an area of 1 million square miles (2.5 million square kilometers) and 26 million inhabitants. The agriculture sector is by far the largest and dominant; the Sudanese economy has always depended on agriculture for growth. It contributes generally 38% to 40% of gross domestic product, accounts for 95% of exports, employs 70% of the labor force, and provides raw materials for agro-industries — namely oil, sugar, textiles, and food industries. Public investment in agriculture averaged 26% annually from 1981 to 1991.

* First Under-Secretary for Agriculture, Ministry of Agriculture, Natural and Animal Resources, Sudan.

Other sectors, such as transport, energy, and commerce, are interdependent with agriculture. The government therefore fully realizes that the productivity and efficiency of the agricultural sector is central to economic recovery and sustained growth. Private investment is strongly encouraged in this context.

Sudan Has Developed an Agricultural Strategy. In broad terms, the Government of Sudan based its agricultural strategy on

- attaining food security, leading to self-sufficiency in important food commodities
- developing and promoting agricultural exports to secure foreign exchange
- maintaining equity between regions
- conducting agricultural activities in a balanced natural environment where they can be sustained

This strategy was initiated in the 3-year Economic Salvation Program (1990 to 1993) and detailed in the already-started 10-year National Strategy Plan (1993 to 2002), of which 1993 to 1996 constitutes the first phase.

The success of such an ambitious strategy will depend on the active participation of the rural population. Well-conceived macroeconomic and agricultural policies geared towards monetary, trade, and exchange-rate policies provide a framework for motivating farmers and encouraging them to remain in the job.

Furthermore, the government recognizes that achieving peace and stability in the southern states, to which it is strongly committed, is important. The government began restructuring the economy as far back as 1991 when prices of agricultural crops were liberalized.

Economic restructuring was further spurred in February 1992 when the government adopted outright market economics and started privatizing some state-owned enterprises and activities, including production parastatals and marketing and agricultural services. Those policies produced a mix of positive and negative results that are being evaluated.

Specific strategic policy priorities in agriculture include

- utilizing available irrigation to the maximum to ensure reasonable food security despite seasonal variations in rainfall
- attaining sustainable growth in traditional rainfed crops of cereals, oil crops, animal production, gum, arabic, and so on
- developing the rural infrastructure, namely transport, markets, storage, and water supplies
- promoting adaptive research, packages of technology, and extension

The Government is Committed to Irrigation. In addressing perspectives of Global 2000 in Sudan, I would like to highlight the Sudan government's commitment

- to make full use of available irrigation equipment by keeping it maintained
- to invest in new irrigated areas as resources become available, balancing such investments with the needs of the extensive potential rainfed sector

These resource allocations will be matched with appropriate crop rotations, proper cropping intensity, and profitable farming systems. In this context, the impact of projects such as SG 2000 is important insofar as it tests available technologies for important crops. The SG 2000 methodology could be utilized for other suitable crops when the extension service is in place.

Irrigation contributes significantly to increasing crop yields (Tables 1 and 2). The irrigated cropped area was increased from 2.42 million feddans in the 1984-88 period to 3.72 million feddans in 1991-92 by exploiting unused capacities in gravity and pump schemes and by limited horizontal expansion.

SG 2000 Triggered Great Interest. The work of SG 2000, in close association with national organizations, from 1986 to 1991 with sorghum and from 1987 to 1992 with wheat under irrigation, triggered great interest in Sudan farming enterprises.

Table 1. Estimate of annual commodity production in the 1992-93 season and the contribution of irrigation.

Cereals	Production (000 metric tons)	% contributed by irrigation
Sorghum	3900	22
Millet	415	2
Wheat	450	100
Maize	20	80
Oil seeds		
Cotton	280	95
Groundnuts	320	40
Sesame	180	0
Sunflower	40	5
Cane Sugar	420	100
Vegetables and fruits	400	80

Table 2. Time series in cereal production in Sudan

Crop	1985-86 to 1989-90	1990-91	1991-92	1992-93
	Production (000 metric tons)			
Sorghum	2,828	1,180	3,540	3,960
	(520) *	(555) *	(641) *	(754) *
Millet	302	84	308	424
Wheat	239	680	895	482
	(586) *	(616) *	(976) *	(550)
Total	3,389	1,944	4,743	4,866

* Yield kg/feddan (feddan = 1.08 acres)

The approach of laying out demonstration plots, distributed over wide areas and grown with farmer participation, brought extensionists and researchers closer to reality. This favorably coincided with the Agricultural Research Corporation's (ARC) joint crop-improvement programs through on-farm research — delivering packages of technology and evaluating the results.

SG 2000 filled a great void in sorghum and wheat improvement. Important components of the package — tested separately at research stations — were improved seeds, fertilizer, and modern agronomic practices (including proper land preparation, planting dates, irrigation practices, plant populations, and so on). Field days were well-attended and highly commended as a means of disseminating information and interacting with enlightened Gezira tenants.

Increasing productivity of irrigated sorghum and wheat is important to Sudan in light of rising costs of production and competition for resources. Evidence of much-increased yields is coming from the national program and areas reached by Global 2000 in the Gezira Blue Nile and White Nile schemes.

An international conference on wheat in warm irrigated climates by CIMMYT, ICARDA, and ARC in February 1993 was a landmark in production of that cereal grain.

Recognizing the marginal nature of much of the Sudan for wheat production, achievements have been spectacular. (Average temperatures are above 20°C for the coolest months and the growing season is short — not more than 100 days.)

In light of last season's experience, where both low prices and high cost of production discouraged growers, the Government of Sudan is considering motivating farmers to

increase wheat production this coming season though well-planned price incentives and favorable credit terms. A fertilizer subsidy also is being considered.

Government Will Cut Barriers to Higher Yields. The government is planning to remove all barriers towards farmers attaining much higher yields — 1 ton per acre of wheat is considered a reasonable target. Available evidence indicates that the number of farmers attaining more than 1.5 tons per acre is increasing year after year and yields of 3 tons per acre were reached by many.

SG 2000 records over five seasons of varying conditions and covering 6,000 acres, averaged 1.2 tons per acre of wheat, with much higher upper limits. Plots at research stations maintain record average yields of 1.5 tons per acre in seasons with varying conditions.

Proven success with sorghum grown under irrigation will be consolidated through farmer motivation. The Government of Sudan envisages that well-adapted sorghum packages of technology can yield spectacular results. Improved varieties, namely Hageen Dura, and open-pollinated local varieties can easily yield 1.5 tons per acre. This can go a long way towards achieving food security from irrigated areas alone.

Exploring Areas of Common Interest

I presume we are here to interact on international, regional, and national cooperative endeavors and to explore areas of common interest between African countries.

To SG 2000: We welcome you to Sudan to augment already-achieved results. The following agenda may serve as a basis for discussions; we could consider

- moving to other unattended wheat production areas such as Rahad and New Helfa (150,000 acres) and placing some emphasis on irrigation management at seeding
- improving sorghum production in New Helfa (generally known for slow change and lack of effective extension methodology)
- continuing the work started with maize introduction and development in close collaboration with ARC
- considering, at a later stage, millet improvement in Kordfan Province now that some on-farm research results are available for demonstration

To the CGIAR centers and donors: We look to you for support in updating our national agricultural research system and putting extension in place to increase our research capacity in this age of economic restructuring and market economies that are so demanding technically.

To sister African countries: Let us not lose time in sharing our experiences in ways to overcome recurrent food problems in Africa.

Competition for Sudan's Irrigated Land Resources in Gezira

Rashid Hassan*

Since Sudan's independence, national development plans and funds have focused on expanding and rehabilitating the productive capacity of its irrigated sector. Over the past three decades, the total area of irrigated land has doubled to more than 2 million hectares, which is the largest area under irrigation among African countries.

The study I am reporting analyzes the efficiency with which resources are allocated and explores the comparative advantage of alternative crop enterprises in using Sudan's irrigated land resources. There are several reasons for such an analysis.

First, irrigation continues to be important in the national economy. All the wheat and sugar, 90% of the cotton, 40% of the groundnuts, and about 20% of Sudan's sorghum production comes from the irrigated sector (Ministry of Finance 1990). The declining productivity of irrigated agriculture over the past two decades is considered the major cause of Sudan's balance of payments crisis (D'silva 1986, Hassan 1993).

Second, while the public irrigation schemes originally were established to produce cash crops for export, the share of food crops grown on irrigated land has been steadily increasing. An important reason for devoting more irrigated area to food production was the threat that drought posed to the rainfed sector's capacity to produce sorghum, Sudan's basic food staple, in the early 1980's.

Moreover, food aid in the form of wheat, which is the main food for urban dwellers, substantially decreased from more than 60% of total wheat supply in 1986 to a low percentage in the late 1980s (Ministry of Finance 1988). This fact, coupled with Sudan's inability to sustain its huge bread subsidy due to severe external and internal imbalances, caused the government to promote domestic wheat production.

While Sudan's shift from export promotion to import substitution is justified in terms of food security and the stability of its food economy, this strategy needs to be examined in terms of economic efficiency.

Third, the results of 5 years of agricultural research on improving wheat production technologies in farmers' fields in Gezira (Ageeb et al 1990, Hassan & Ageeb 1992) encouraged the government to launch a national campaign in 1989 to achieve self-sufficiency in wheat by 1992. The campaign has had mixed success.

During the 1991-92 season, Sudan produced 90% of the wheat it consumed. In 1992, the area planted to wheat expanded and winter

* Associate Economist, Economic Program, International Maize and Wheat Improvement Center, Nairobi, Kenya

temperatures were exceptionally favorable. This combination of factors allowed Sudan to achieve self-sufficiency that year. However, preliminary estimates indicate that this seasons's harvest from the same area will meet only 60% of Sudan's consumption in 1993. This confirms that 1992 weather was atypical for Gezira, and that area expansion remains the option for achieving wheat self-sufficiency, at least in the short run.

Expanding domestic wheat production will increase competition between wheat and other enterprises for Sudan's irrigated land resources. Therefore, it is important to evaluate the comparative advantage of competing enterprises in this sector.

Fourth, unlike the low-input production systems of the traditional dryland farming sector, agricultural production in the irrigated schemes is input-intensive; it involves mechanization and high rates of purchased inputs. Therefore, a large amount of foreign exchange is required, especially to attain the high yields that are possible with the package of improved practices. This is because the improved package requires increased use of imported modern inputs.

Hence, it is important to compare the foreign exchange resources required to support local wheat production with those saved by reducing wheat imports.

Accordingly, the main objectives of this study are to determine the comparative advantage of wheat versus alternative enterprises in using the country's irrigated land resources and to evaluate Sudan's wheat import substitution in terms of economic efficiency.

The study examines the efficiency of wheat production in the Gezira scheme, which constitutes about 50% of the total area under irrigation and contributes more than 60% of Sudan's wheat and cotton production. Also, all the other irrigation schemes follow the Gezira design and mode of operation. The study is part of CIMMYT's global research to define conditions for competitive and efficient wheat production, especially in the warm subtropics where the environment is unfavorable for wheat production.

Gezira Cropping Structure and Competition

The Gezira scheme lies between the Blue and White Nile rivers south of Khartoum. Gravity irrigation feeds water to Gezira from the Sennar Dam on the Blue Nile through a network of irrigation canals.

The total area of the scheme is .88 million ha, which is divided into 102,000 tenancies of 8.4 ha each. Each of the 8.4 ha tenancies is divided into four 2.1 ha plots. Four crops — cotton, wheat, sorghum, and groundnuts — are grown on the plots in a four-course rotation. Each year, the farmer is required to plant cotton on one 2.1 ha plot, wheat on another, and a combination of groundnuts and sorghum on the third. The fourth plot is left fallow.

Thus, the four phases of the rotation on a plot are completed in 4 years as wheat follows cotton in the second year, the sorghum-groundnuts combination in the third, and fallow in the fourth year. The same sequence is followed on the other three plots so that each year the farmer will have a plot in cotton, a plot in wheat, a third in the sorghum-groundnut combination, and a plot lying fallow.

Each phase of the rotation occupies 25% of the land in Gezira. This means that 210,000 ha are left idle every year in the fallow phase. While the fallow phase helps in managing fertility and controlling pests and diseases, the availability of water is the main factor limiting the total area being irrigated.

The Gezira irrigation network originally was designed to support only 50% cropping intensity — that is, only half of the land would be irrigated at a time. Introducing wheat as a winter crop in the rotation made the 75% cropping intensity possible.

This plan suggests that there is no direct competition for land between the four crops. In other words, the area planted to wheat or to any of the other three crops can easily be doubled if the irrigation system infrastructure is expanded to supply water to the remaining 25% of the land.

Water Availability Affects Cropping Intensity. While the above-mentioned capacities are theoretically possible, in fact, due to water shortages, the average cropping intensity in Gezira was only 62% over the past 30 years — only 62% of the land was cultivated. The 75% cropping intensity was realized, on average, only once in 5 years. Higher cropping intensity is achieved during summer than in winter; water shortages are more severe during winter due to lack of rains and lower river levels.

The total area planted under the four-course rotation is determined by

- the amount of water available (stored) at the Sennar dam
- the carrying and conveying capacity of the irrigation network
- water requirements of the four crops

(Plusquellec 1990, Ahmed et al 1989, Farbrother 1984)

The area allocated to each of the four crops is then determined by the government's strategy and priorities with respect to food supply and foreign exchange needs. The general economic situation determines government priorities for a given period.

Twice — in 1972 and in 1988 — during the past 30 years, self-sufficiency in wheat was set as one of the main goals of Sudan's agricultural development plan and national campaigns were launched to achieve that goal (Ageeb et al 1990). As a result, areas sown to wheat in years following those declarations rose to record highs. In fact, it was only during those times that wheat used its maximum share of the land in Gezira.

The data also suggest that the competition between wheat and cotton is stronger than the competition between sorghum and cotton.

During the 4-year period 1982 to 1986, substantial amounts of wheat as food aid were contributed to Sudan, accounting for more than 50% of its total consumption (Ministry of Finance 1988). This reduced the urgency of expanding domestic wheat production. Moreover, a severe drought hit the country during that period, being worst during the 1984-85 season when no wheat was grown due to extremely low river water levels. Both cotton and wheat areas — as well as the overall cropping intensity — declined during that period.

Crops Compete for Labor and Mechanical Power. The cropping calendar and peak demand for resources is as follows:

- Cotton is the only crop that remains on the land after wheat is planted.
- The peak labor demand for wheat comes between mid-October and mid-November, especially when the sorghum and groundnut harvest is delayed and overlaps wheat planting and first irrigation.
- Three major operations overlap in wheat and cotton production; irrigation, weeding, and harvesting. The fact that wheat is not weeded and is mechanically harvested — whereas cotton weeding and harvesting are

labor intensive — minimizes competition for labor and machinery between the two crops.

Cotton is considered wheat's main competitor, with irrigation water being the limiting factor and the source of indirect competition for land between the two crops.

New Technologies Were Tested in Gezira. A new package of improved wheat production practices, developed by Sudan's Agricultural Research Corporation (ARC), was extensively tested in farmers' fields in Gezira over the past 8 years under the joint ARC-International Center for Agricultural Research in the Dry Areas (ICARDA) pilot project for verification and adoption of improved wheat technologies in Sudan.

Versions of the ARC package have been tested independently in farmers' fields by the Sudan Gezira Board (SGB) and the Sasakawa Global 2000 (SG 2000) project. The tests showed that wheat yields increased substantially from good seedbed preparation, optimal sowing by machine, and timely application of adequate amounts of fertilizer and water (ARC-ICARDA, SG 2000).

However, despite the wide-scale demonstration of the recommended practices, farmers have been slow to adopt the new technology and wheat productivity has grown only slowly. While the area sown to wheat has expanded rapidly over the past 8 years, wheat yields have grown more slowly.

Annual growth rates were estimated by an exponential trend model to be 16% for area and 4% for yield. Wheat farmers achieved an average yield over the 8 years of 1.42 t/ha, which is only 11% higher than the long-term average of 1.28 t/ha for the 20-year period preceding 1986 (Hassan and Faki 1993).

This shows that a wide gap exists between the high potential for wheat production revealed by ARC and SG 2000 and current yield levels.

Several studies have argued that a major reason for the yield gap is the slow adoption of the package of improved practices (Hassan and Ageeb 1992, Faki 1991). These studies suggest that, because of a lack of inputs, particularly fertilizer and irrigation water, many farmers could not use the full package of technologies. Table 1 shows the effects of three levels of adoption of improved wheat technologies.

The adoption of timely and adequate applications of fertilizer and water has been low compared to adoption of the mechanical components (except for mechanical application of fertilizer). This is due primarily to differences in the way input markets are organized in Gezira.

The SGB is responsible for procuring and distributing seeds and fertilizers to farmers. Most of the mechanical operations are hired from private dealers. Thus, the level and timeliness of fertilizer application are beyond farmers' control. Private market arrangements seem to function more efficiently in delivering machinery services. This may explain the low adoption of the chemical, relative to the mechanical, components of the new technology.

The number of irrigations a farmer is able to apply depends on several variables, such as total water availability (rainfall, river level, and so on), location of the farm in the scheme, and the land's relation to the irrigation canal. The scheme's physical and infrastructure constraints limit farmers' ability to exploit the yields that could be possible with adequate irrigation.

Market distortions could relatively easily be eliminated through liberalizing policies for

procuring and allocating inputs. On the other hand, substantial investments in rehabilitating the existing infrastructure would be required to improve the supply and distribution of irrigation water.

SG 2000 Farmers Adopted More New Technologies. The relatively higher rates at which SG 2000 farmers adopted new technologies as compared to the average explains the wide yield gap between the two groups (Table 1). Farmers participating in SG 2000 enjoy more timely and adequate deliveries of the recommended inputs.

Interestingly, ex-SG 2000 farmers also have higher-than-average adoption rates and yields (Table 1), indicating that SG 2000 field demonstrations effectively transfer wheat technologies.

Table 1. Percent of farmers adopting components of the improved wheat production technology in Gezira (1989-1990)

Technology component	ARC full package	All-scheme average (1989/90)	SG 2000 (1989/1990)	Ex-SG 2000 (1989/1990)
Improved variety				
Condor	100	58	56	100
Debeira	0.0	40	33	0.0
Giza 155	0.0	2	11	0.0
Mechanical				
Disc harrow	100	40	90	62
Leveling	100	31	100	100
Mechanical planting	100	44	79	54
Mechanical application of fertilizer	100	8	62	5
Chemical				
Full nitrogen dose	100	22	98	92
Average level used (kg/ha)	(86)	(59)	(82)	(76)
Recommended phosphorus dose	100	18	92	72
Average use (kg/ha)	(43)	(8)	(26)	(34)
Optimal date of application	100	11	78	71
Other				
Optimal sowing	100	97	96	100
Optimal date for first watering	100	80	90	86
Optimal number of irrigations	100	16	80	74
Average number applied	(7.4)	(5)	(6.2)	(6.4)
Average yield (t/ha)	3.7	1.4	2.8	2.3
Number of farmers	18	80,000	111	111

Source: Ageeb et. al. (1990), Sudan Gezira Board, Annual Reports (Various issues), Survey data (1989/90), SG 2000, Annual Reports (1989&1990), and Faki (1991).

While the preceding analysis reveals the high yield levels that farmers can achieve with the full package of wheat recommendations, all farmers may not be able to attain them for several reasons.

The prospects for all farmers achieving the timely delivery of the same quality of inputs as was possible for farmers under ARC's supervision are not great. This is particularly true for inputs such as irrigation water, which farmers or scheme management do not control; only 16% of the farmers were able to apply seven irrigations on wheat in 1990 (SGB 1990).

Even if all other inputs were available at the right time to all farmers, irrigation water cannot be evenly distributed across the 0.9 million ha Gazira scheme, and thus many farmers may not able to apply enough water to achieve potential yields.

Accordingly, an intermediate technology — using no phosphorus, less than seven irrigations, and conventional leveling — was evaluated at the Gezira Pilot Farm. The three technology levels — the traditional practices that have dominated wheat production in Gezira, the intermediate technology, and the full package of new wheat production methods — are compared in Table 2.

For the intermediate technology and the ARC demonstrations, average yields are adjusted to levels attainable under farmers' conditions and management by using the 82% achievement factor of former SG 2000 farmers in Table 1. The all-scheme average yield for the past 8 years was used as the yield level attainable under traditional practices. As this average represents an improvement over the past, due to partial adoption of the improved practices by some farmers, input use and adoption rates shown in Table 1 were used to represent the traditional technology level in Table 2.

Because information about potential improvements in cotton practices was not available, alternative technology levels for cotton production could not be used. The average production methods currently applied on cotton in Gezira is the only technology used for both long- as well as medium-staple cotton.

The domestic resource cost (DRC) framework was used in this study to evaluate the comparative advantage of wheat versus long- and medium-staple cotton.

Table 2. Wheat technologies in Gezira

Practice	Traditional technology	Feasible intermediate technology (Pilot Farm)	Potential full package (ARC technology)
Seed rate (kg/ha)	120	143	143
Nitrogen (kg/ha)	60	86	86
Phosphorus (kg/ha)	0.0	0.0	18.4
Disc harrow	4 [a]	Yes	Yes
Number of irrigations	5	6	7
Leveling	3 [a]	Conventional	Conventional
Precision			
Planting method	4 [a]	Mechanical	Mechanical
Mechanical			
Yield (t/ha)	1.42	1.89	3.05

a Represent the percent of farmers using: i.e. rate of adoption.

Previous DRC studies (Ministry of Finance and Economic Planning 1992 and 1989, Nashashibe 1980, Sigma One Corporation 1983, Jansen 1986) yielded mixed results. However, none of those studies evaluated the efficiency of the potential new wheat production technology tested by ARC and SG 2000. In this study, the three levels of wheat production technologies were compared to cotton, with costs and returns disaggregated into technical parameters and nominal values (prices) for quick updating.

For wheat to be the most efficient user of Sudan's irrigated land resources, the foreign-exchange cost of producing wheat locally must be less than its import price. However, this measure of economic efficiency is sufficient only when other production alternatives are not available.

The DRC ratio measures the relative efficiency of wheat compared to the other enterprises in terms of the cost, in local currency, of domestic resources required to save or generate one unit of foreign exchange. This coefficient is then compared to the effective or parallel exchange rate.

An easier alternative measure of economic efficiency is the resource cost ratio (RCR). The RCR is obtained by expressing both the numerator and denominator in the same currency units. An RCR value between 0 and 1 implies that value added per unit of product is larger than the value of domestic resources used to produce that unit and, hence, the commodity has comparative advantage.

The major difficulty with using DRC and RCR methods lies in placing values on inputs and outputs. This is particularly so when choosing the appropriate price for non-traded factors such as land, labor, capital, and water — especially when there is no market for the resource(s). Also, the prices of tradable inputs often do not correspond to their true economic value due to market imperfections and distortions caused by government intervention to control prices and ration the distribution of goods. The DRC framework, therefore, distinguishes between market (private) and economic prices.

Profitability is Measured by Enterprise Budgets. Enterprise budgets were constructed to analyze profitability. Technical coefficients for the physical input-output relationships associated with producing and marketing wheat and cotton were compiled from various surveys (Hassan and Faki 1993). Two regimes — market pricing and economic pricing — were used to price inputs, services, and products.

Market pricing. Actual prices that farmers paid for inputs and prices they received for their output were used to compute private profitability. The average wage rate in the scheme was used as the price of labor. Land and water are not freely traded in Gezira, although farmers are charged for their use — these charges were used to represent the private cost of using these resources. The effective price of capital was set at the capital service charge applied by commercial banks, which was 30% per annum on short-term lending in 1993.

A further factor was accounted for. A new credit system called Salam was introduced during the 1992-93 season. In this system, farmers enter an agreement with the newly established Farmers Credit Bank to sell short their cotton and wheat crops at a fixed price that is set at the beginning of the growing season. The bank then advances loans to farmers based on this fixed price. Farmers deliver the crop to the bank at harvest and the bank sells the crop.

Economic pricing. For analyzing social profitability, market prices of tradables were adjusted to reflect the true economic values of commodities. Thus, world prices were converted into Sudanese pounds, using the shadow rate of exchange, which was considered to be the free market exchange rate prevailing in 1993. At harvest time US$ 1 was charged at Sudanese pounds Ls 200. Again, capital was valued at the capital service charge of 30% per annum on short-term lending by commercial banks and the average wage rate on the scheme was used as the opportunity cost of labor. Net private and social returns per hectare of land and per millimeter of irrigation water were calculated at trend prices for 1993.

Private profitability was evaluated for the new Salam credit system and for direct or commercial financing. Results are summarized in Table 3. For farmers participating in the Salam system, medium-staple cotton growers earned the highest net private returns per ha and per mm of water. Long-staple cotton and the full package of improved wheat technology ranked second, with almost equal returns per mm of water.

On the other hand, farmers who sold their wheat and cotton directly to traders and cotton marketing agencies made higher profits per mm of water from all wheat technology levels than from long- and medium-staple cottons. This shows that prices paid for cotton were more favorable than wheat prices under the Salam system. In other words, the Salam system did not favor wheat.

However, the ranking changed under economic pricing (Section B). Medium-staple cotton generated the highest economic returns per mm of irrigation water, followed by full package wheat and long-staple cotton. The intermediate and traditional wheat technologies — which are the most common in Gezira — were dominated by both medium- and long-staple cotton (Table 3).

Social pricing revealed distortions created by the various input- and output-pricing policies that were in effect in Sudan in 1993. Section C of Table 3 shows such policy distortions by calculating the net policy effect (NPE) and the effective protection ratio (EPR) for the competing crop enterprises. The negative values of NPE and of EPRs indicate that both cotton and wheat producers were heavily taxed in 1993.

On the other hand, Gezira farmers benefited from indirect subsidies on fertilizers and machinery through the overvalued exchange rates applied to imports of these products. At the shadow exchange rate, however, the tax on farm products was higher in 1993 than the subsidy on inputs used on wheat and cotton. Table 3 shows that, if the shadow exchange rate of Ls 200 to US$ 1.0 was the true value of Sudanese currency in 1993, traditional wheat growers in Gezira paid a net tax of more than Ls 180,000 or US$ 900 on their 4.2 ha cotton-wheat tenancy or more than US$ 200/ha.

These results indicate that cotton production paid a much higher tax compared to wheat in 1993. Such a distortion in relative prices and terms of trade bias the structure of incentives against cotton and lead to inefficient allocation of productive resources away from cotton and into wheat. In brief, Table 3 shows that, unless the improved wheat production technology of ARC is fully adopted, wheat cannot compete with cotton for a socially optimal allocation of productive resources in Gezira. Farmers, however, will continue to earn higher returns on wheat than cotton if current price policies continue to tax cotton production relative to wheat.

When DRC ratios were calculated for the five crop enterprises, using long-run price trends in 1993, medium-staple cotton dominated the three wheat technology levels. While traditional and intermediate level wheat

technologies were highly inefficient under trend prices (Table 3), full package wheat was slightly more efficient than long-staple cotton.

Cotton Could Command Higher Prices. Due to a number of processing and marketing problems that have seriously affected its quality, Sudan has been receiving almost half the world price of comparable products, such as Egyptian cotton. Sudan cotton could command a much higher price if its processing and marketing problems were solved.

Investigating the potential gains from research and investment in solving these problems was beyond the scope of this study. However, it is important to test the efficiency limits of wheat production in Gezira against possible movements in the world cotton-to-wheat price ratio. It also is important to recognize the imperfections in the world wheat market and the prospects for higher world wheat prices in the future.

Sensitivity analysis to delineate the region of economic efficiency of wheat production in

Table 3. Net private and economic returns to land and water in Gezira and resource cost ratios at the 1993 trend prices

		Cotton		Wheat Technologies		
		Long staple	Medium staple	Tradi-tional	Inter-mediate	Full package
A.	**Net private returns to land (Ls/ha)**					
	under Salam financing	11,466	14,266	537	1,059	6,753
	under direct financing	20,620	23,167	10,359	14,296	29,012
	Net private returns to water (Ls/mm)					
	under Salam financing	3.9	4.9	0.4	0.7	4.0
	under direct financing	7.0	7.9	8.5	9.8	17.0
B.	**Net economic returns to land (Ls/ha)**	95,306	111,901	22,701	30,749	56,712
	Net economic returns to water (Ls/mm)	32.5	38.2	18.6	21.0	33.2
	Value added (Ls/mm)	37.3	43.5	26.2	27.5	40.0
C.	**Measures of policy distortion[a] Direct financing**					
	NEP(A-B)(Ls/ha)	-74,686	-88,734	-12,342	-16,453	-27,700
	EPR	0.30	0.29	0.47	0.55	0.56
D.	**Resource cost ratios** (1993 trend prices)	1.2	0.9	1.7	1.6	1.1

a NEP denotes the net policy effect and EPR the effective protection ratio. EPR is the ratio of value added (VAD) at market prices to the VAD at social prices.

Gezira shows that the world wheat price has to rise to US$ 147/t for full-package wheat technology to become efficient at current yield levels. This means that the world wheat price has to be about 5% higher than trend prices for full-package wheat to become the most efficient alternative in Gezira.

These data indicate the narrow margin of economic efficiency and dominance of medium-staple cotton over full-package wheat in terms of relative and absolute price movements. This is important since the world wheat price may be higher under the unfolding new international economic order of freer world trade.

For yield levels currently obtained in Gezira under traditional wheat practices to become efficient, the import price of wheat has to be higher than US$ 220/t, which is more than 57% higher than the 1993 trend price and about 38% higher than the actual price of wheat during the first half of 1993. This indicates that a substantial shift in the relative world price of wheat is needed for the traditional wheat practices followed by the vast majority of farmers in Gezira to compete with cotton for the irrigated land resources of the scheme.

Conclusion

The proportion of irrigated land devoted to food production has steadily increased in Sudan over the past two decades. The country's severe food shortages after the 3 years of drought of the early 1980's, reduced availability of wheat aid, and encouraging results of on-farm tests of improved wheat production practices caused Sudan to strive towards self-sufficiency in food, particularly wheat.

This study used relative profitability analysis and DRC methodology to evaluate the comparative advantage of traditional and improved wheat technologies versus cotton in Gezira to determine if wheat is the most efficient option for using Sudan's irrigated land resources. Results of the profitability analysis showed

- both wheat and cotton production are heavily taxed under the current pricing and credit policies in Sudan
- the tax is higher on cotton growers than on wheat producers
- at 1993 trend prices, medium-staple cotton dominated all three wheat technology levels in terms of economic efficiency.

Sensitivity analysis showed that a world wheat price 5% higher than its long-run trend will be required for full-package wheat to become the most efficient alternative. As Sudan currently imports wheat at a cost that is much higher than the long-run trend price, full-package wheat showed comparative advantage over cotton at actual 1993 prices. Since average yield levels in Gezira are much lower than yields obtained under the full-package technologies, it may not be economically efficient for Sudan to expand wheat production at the expense of cotton in Gezira.

Before more land and water are switched from producing cotton to wheat, the gap between potential and farmer's wheat yields needs to be closed so as to make wheat farming efficient. Sensitivity analysis showed that Gezira tenants who currently produce wheat by traditional methods would have to raise their yield levels by more than 34% — from 1.42 t/ha to 1.9 t/ha — to compete with cotton at 1993 price levels. Sudan's policy-makers therefore need to consider

- removing the obstacles to higher and faster adoption of improved wheat production technologies tested by ARC in Gezira

- liberalizing input procurement and delivery systems for more efficient and timely utilization of modern inputs
- allocating land and other resources among competing crops within the public irrigation schemes more flexibly so domestic resources can respond to changing international economic opportunities

On-farm testing of the new wheat technology should continue — particularly at locations where water shortages are severe — to realize the yields that can be obtained. Adaptive research should modify the ARC package of wheat technologies to fit different locations in the scheme.

Sudan should increase its research budget and its efforts to refine the lint quality and improve the marketing processes of its cotton crop. This is crucial for economic efficiency, as potential yield gains from improved wheat production methods need to be weighed against potential gains from upgrading cotton quality.

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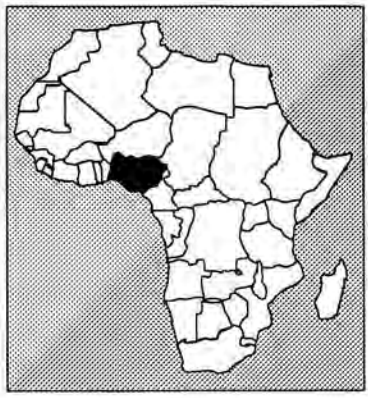
Small-Scale Irrigation Development in Northern Nigeria**

Wada I. Dederi*

Small-scale irrigation farming is widely practiced in sub-Saharan Africa. Nigeria has substantial potential to further develop small-scale irrigation. The northern part of the country is dry, with sparse vegetation and extensive fadama lands. (Fadema is a Hausa word meaning a wet, swampy area, including floodplains and uplands that are waterlogged during rainy seasons.)



Small-scale irrigation in northern Nigeria helps increase food and cash-crop (vegetables) production, reduces drought risk, and lowers crop risk from insufficient rainfall — particularly in maize and rice — during the wet season. Also, it reduces rural to urban migration by providing employment opportunities for the able-bodied rural youths.

The introduction of the World Bank-assisted Agricultural Development Project system in the state in the early 1980s provided an opportunity to widen the scope of fadama-based irrigated production. The fadama project was implemented by the Kano Agricultural and Rural Development Authority (KNARDA) and was completed in 1989.

The irrigation program expanded at a fast rate and farmers readily accepted most of the new technologies introduced. About 225% more hectares were brought under fadama irrigation during the life of the project than were targeted. It culminated in the successful introduction of modern irrigation techniques — tubewell, washbore, fadama rehabilitation, and surface water pumpings. Also, new high-yielding crops — such as vegetables, pulses, and forage crops — were introduced.

The Federal Government took over the project under its River Basins Development Authority irrigation program. Eight additional small-scale irrigation schemes have been developed in the state and are managed by the state's Ministry of Agriculture and Natural Resources (MANR).

The objective of this paper is to review the small-scale irrigation potential in sub-Saharan Africa and Nigeria and, in particular, to discuss the KNARDA irrigation program in northern Nigeria and relate it to future development considerations.

Small-Scale Irrigation in Sub-Saharan Africa

Available literature indicates that small-scale irrigation technology dates back to the ninth century. Small-scale irrigation plays an important role in producing food and cash crops in sub-Saharan Africa, much of which is endowed with fertile land, water, and weather to produce both tropical and temperate crops.

* Managing Director, Kano Agricultural and Rural Development Authority, Nigeria

** Presented by G.I. Diggal, Director, Monitoring and Evaluation, KNARDA

According to the UN Food and Agriculture Organization (FAO) (1986), the region has a small-scale irrigation potential of 33,643,000 hectares, only 7% of which is developed. And it estimated that existing schemes might expand at an annual rate of 4%. Furthermore, the FAO report identified two forms — village-level and individually or family-operated schemes.

The village scheme usually is comprised of 10 to 50 hectares. The government controls the land and its development and leases the land to individual farmers.

The individually or family-operated scheme may range from 0.5 to 5 hectares and, rarely, up to 10 hectares. The land belongs to the individual or the family. There is no formal irrigation infrastructure, except for seasonal traditional basins and channels.

Although weather variables play a significant role in irrigated crop production, prime considerations in success of the technology are the source, availability, reliability, quality, and efficient use of water. Barnet and Ball (1982) indicated that small-scale irrigation is based on

- receding or advancing floodplains, inland valleys, lakeshores, and central swamps
- small earthen dams using gravity or pumping or manual methods to distribute water
- small run-off (river diversion)
- wells or open water, using manual labor, animal power, or motorized pumps to lift the water
- water harvesting or spreading, usually by simple bunding, in areas where season spates or flash floods discharge onto flat land

Small-Scale Irrigation in Northern Nigeria

Nigeria is one of the 40 countries that make up the sub-Saharan region. It has a total land area of 98.3 million hectares, of which 74% is cultivable and less than 1% is under traditional — small-scale — irrigation. Most of the small irrigation activities in Nigeria are carried out in fadama. According to estimates by Awogbade and Famoriyo (1982), Nigeria has an irrigation potential of almost 16 million hectares and 40% of this could be developed under small-scale irrigation.

The former 11 northern states, now 16, have a combined potential for small-scale irrigation of 3 million hectares, according to recent World Bank (1992) estimates.

The need to develop irrigation schemes in northern Nigeria is compelling. The climate is semiarid, vegetation is typically savanna, rainfed production is less than 4 months, and average annual rainfall ranges from 450 to 500 mm. These unfavorable climatic conditions usually lead to low yields of rainfed crops and drought usually occurs every 3 to 4 years.

Small-scale irrigation can mitigate the effects of drought. Where small irrigation schemes exist, smallholders grow a minimum of two crops per year. The smallholders predominantly are subsistence farmers, well experienced in fadama-based irrigated production.

Small-scale Irrigation Has Changed Northern Nigeria. Development of small-scale irrigation has wrought changes in northern Nigeria. Before the government's involvement in small-scale irrigation development two decades ago, most of the fadama lands were considered — and in some states gazetted — as grazing reserves. This was because, at the end of the wet season and when cattle had exhausted their upland grazing

lands, the cattle rearer moved his animals to the fadamas for abundant grazing and water. (Awogbade and Famoriyo, 1982).

Due to the Federal Government's involvement in developing river basins in the late 1970s through the early 1980s, and the expansion of small-scale irrigation through the World Bank-assisted Agricultural Development Authorities, the grazing reserves have been converted to arable irrigation farming. Consequently, the cattle rearer, particularly in the northwest and northeast of Nigeria, has become marginalized.

Another change has been caused by more modern irrigation methods. The traditional means of irrigating small plots was the shadoof, by which water is lifted from an open well, normally on a river-bed, to water the crops. It, and other traditional forms of supplying irrigation water to crops, is laborious and can irrigate less than an acre per day; most of the smallholders used the traditional shadoof for watering .1 to .2 ha vegetable plots. Mijindadi, Umar, and Tyem (1993) observed that, as of 1985, about 20,000 hectares were being irrigated by traditional techniques.

With the introduction of new methods under the Agriculture Development Authorities, the irrigated acreage rose to 179,020 by 1992. The new methods include wash bores, tubewells, lift irrigation by direct pumping, and diversion of flood control.

Let us now narrow our focus to the erstwhile Kano State in northern Nigeria. It lies between latitude 13°53' and 10°25' north and longitude 7°40' and 10°35' east. It covers an area of 43,000 km^2 and contains approximately 947,000 farm families with a mean family size of eight persons (Knarda, 1987).

The evolution and interrelationships of irrigation projects in Kano State is complex.

The state has an identified irrigation potential in fadama of 132,000 hectares, not including the 22,000 hectares identified under the Hadejia River Basin Development Authority (HRBDA).

Most of the small-scale irrigation sites in Kano State are individually or family operated, with size varying from 1 to 2 ha. In addition, the state government — through its Ministry of Agriculture and Natural Resources (MANR) — has developed eight small-scale irrigation schemes.

Kano State government started developing irrigation schemes with the famous and successful Kano River Project in the early 1970s. Later, this project was taken over by the Government of Nigeria. Since then, the Kano River Project, along with other irrigation projects in Bauchi State metamorphosed to the Hadejia Jama'are River Basin Development Authority (HJRBDA).

The HJRBDA has an irrigable area of 22,000 ha, of which 15,000 ha have been developed and are being used by smallholders.

The developed irrigation resources provide year-round cropping, increasing cropping intensity from less than 75% under rainfed conditions to more than 200% under small-scale irrigation. This has made possible the introduction of new crops, such as wheat, barley, chickpea, greenpea, cabbage, and cauliflower. It also has made possible production of traditional crops, namely rice, maize, cowpea, onion, tomato, okra, and so on during the dry season.

KNARDA Small-Scale Irrigation Development

Focusing now on the irrigation component of KNARDA, which was established in 1982 with the main objective of increasing food production on about 900,000 ha involving

430,000 farm families. It was envisaged to cultivate an addition 27,480 ha under small-scale irrigation.

Because subsistence smallholders are dominant, the state government looks to developing small-scale irrigation as a way to grow more food and provide jobs for the teeming rural populace. KNARDA small-scale irrigation development has increased the amount of land cultivated and it has introduced new technologies for developing the fadama resources.

The program to develop small-scale irrigation on the additional 27,480 ha included exploitation of surface-water resources by direct pumping, introduction and promotion of tubewells and washbores, rehabilitation of old fadamas, and completion of the water irrigation schemes.

The World Bank Staff Appraisal Report (1981) provided targets to be achieved through three main activities as follows:

- To train and encourage farmers to bund and impound runoff and use residual moisture to produce a second cereal crop (sorghum and maize) planted in the September/October period on 14,750 hectares.
- To make available through Kano Agricultural Supply Company, 1,500 3" diesel pumps and 4,600 handpumps to exploit shallow ground water, replacing the shadoofs, bringing an additional 6,380 ha into cultivation.
- To improve flood irrigation of rice by bunding an estimated 5,900 ha to facilitate the production of two crops a year — isolation bunds for one rice crop plus residual moisture for one crop.

KNARDA Small-scale Irrigation has Five Dimensions. The KNARDA small-scale irrigation program consists of five dimensions — engineering, extension, adaptive research, group development, and input procurement and supply. Following are highlights of these dimensions.

Engineering. In rehabilitating old fademas, canals were dredged to divert water to areas that formerly were dry. This work was comparatively cheap and allowed the users to control the amount of water they need for irrigation. About 3,700 ha have been rehabilitated.

Washbore jetting was introduced in 1983. The state has a washbore potential of 6,000 ha. Jetting was initially confined to river beds; later it was extended to river terraces that have 1 to 2 meters of clay burden. Farmers were trained to remove the clay burden after which jetting started.

KNARDA successfully extended the washbore technology to the fringes of the Chad formation. This was done with packing around the screen during the development stage to prevent sand from blocking the water flow. During 1983 to 1989, KNARDA teams directly carried out jetting with a 50% subsidy to the farmers.

Tubewell technology was introduced toward the end of 1983. There was a potential for irrigating 20,000 ha with tubewells. A 50% subsidy enabled farmers to adopt the technology.

New water pumps were introduced to ease water lifting, lower the cost of application, and irrigate large areas of land in a comparatively short time. These included hand-operated, solar-powered, and petrol-driven models. Hand-operated sludge pumps

were initially donated to us by the Dutch Government. Bumi and Bellow hand pumps were tested and farmers bought some.

After some promotions, farmers settled for petrol-driven pumps; sales started in 1982 with 200 units of 2" pumps at a 25% to 50% fluctuating subsidy. With the introduction of tubewell and surface-water exploitation, 3" pumps were added.

To enable farmers to enjoy sustained use of their petrol pumps, village mechanics were selected and trained in pump repair by KNARDA. Now, pump mechanics can be found in almost all fadamas.

Extension. Extending information about improved irrigation techniques for use during the dry season is the major component of the KNARDA program. Almost 80% of the extension agents are involved; the remaining 20% are usually assigned to such off-fadama activities as livestock production and crop storage.

Extension pamphlets and video films on improved production methods are designed specifically for extension workers and for farmers. Also, since the training and visit extension approach was introduced, frontline extension agents attend fortnightly training sessions.

In addition to supervising the frontline extension agents, senior extension advisers conduct farmer demonstrations, which essentially are based on the adaptive research program. Similarly, frontline extension agents demonstrate the small plot adoption technique to convince farmers to adopt an improved production recommendation, plant a new high-yielding variety, correct a prevalent problem, or do some other useful activity.

Adaptive research. The adaptive research section conducts trials in different parts of the fadamas in the state, screens varieties for adaptation, tests improved production recommendations, and designs suitable production packages. The section collaborates closely with the Institute of Agricultural Research (IAR), Zaria, and other relevant research institutions such as the International Institute of Tropical Agriculture that have contributed significantly to increasing irrigated crop production.

Adaptive trials are carried out on winter legumes, cereals, vegetables, and minor crops. They also test ways to increase production with residual moisture. The trials focus on such agronomic factors as the best sowing date, appropriate fertilizer rate, and best varieties to plant.

Group development. Initial experience in persuading smallholders to adopt improved production packages was frustrating. Individual farmers were not willing to listen to us and, therefore, person-to-person contact was difficult.

Consequently, a new approach centered around forming groups and fadamas were tagged either as individuals or groups.

- Individual fadamas are owned by farmers and managed to suit their production goals.
- The group fadamas are owned by the government and land use and planning are controlled by KNARDA. Only cooperative farmers are allowed to cultivate the area and participating farmers strictly follow KNARDA recommendations. Through the group fadamas, farmers became attracted to some of the adapted production recommendations, which became quietly and widely accepted.

  Also, the group development section helped farmers market their produce — particularly newly introduced perishable

vegetables, such as Yellow Wonder and green pepper. Some of the groups gained improved credit availability that enabled them to increase production.

KNARDA Collaborates with SG 2000 and Other Groups. KNARDA collaborates with other organizations to find and share information on relevant technologies. A recent collaboration has been developed with Sasakawa Global 2000 (SG 2000). After SG 2000 completed the necessary diplomatic protocols and a reconnaissance study in the country, it chose Kano and Kaduna states for its catalytic project to increase food production.

The agreement calls for the host state to provide office accommodation for the project coordinator and some frontline extension agents to help implement the program.

In Kano State, the SG 2000 agricultural project chose wheat for demonstration during the dry season and maize and cowpea during the wet season. During the 1992-93 dry season, the pilot project involved 160 small-scale farmers, mainly located around the HJRBDA development area.

These smallholders individually cultivate an average of 0.25 ha to 0.5 ha; the project involves an area of about 80 ha planted with improved wheat varieties. SG 2000 encourages farmers to properly prepare their lands in timely fashion and provides inputs on credit.

The pilot demonstration gave the expert SG 2000 team some insights on ways to demonstrate production recommendations under the local conditions. And it uncovered production problems to be overcome, including late land preparation, lack of timely input supply, and farmers' idiosyncrasies in accepting new technologies.

The SG 2000 project has imported high-yielding wheat seed developed at the International Maize and Wheat Improvement Center in Mexico, which is being multiplied on a 10 ha plot at our Kadawa seed multiplication farm. We expect some seed will be available to farmers for planting for the 1993-94 season.

Although the SG 2000 wheat production program in the state is in its first year, many farmers in the Kano River Project area already are aware of it. Solving the takeoff problems constitutes the magic wand to encourage more farmers to participate in the Management Training Plot (MTP) project.

Also there is a developmental need to extend the MTP to fadama areas where, under our adaptive research trials, wheat yields of 4 tons per hectare have been recorded. I am convinced that, with SG 2000 experience and expertise in wheat production — particularly considering the resounding success achieved in Sudan — Kano State farmers could obtain yields of 3 to 5 t/ha per hectare. This would bring dramatic wheat production increases, since the present average yields obtained by farmers are below 2 tons per hectare.

Another example of KNARDA's collaboration with other organizations: It has worked with IAR, Zaria in designing on-station and on-farm trials. And IAR, Zaria has carried out contract research on mixed cropping and provides scientists to train KNARDA's subject matter specialists at the monthly technology review meetings.

Performance of the KNARDA Irrigation Program

In its summary report of KNARDA agricultural programs in 1989, the Agricultural Projects Monitoring and Evaluation Unit (1991) indicated that the small-scale fadama irrigation sector had performed well. It observed that, against the target of an additional 27,480 ha to be brought under cultivation, 61,980 ha had been recorded.

Many washbores and tubewells were drilled; Kimmage and Falola (1991) reported that Kano State KNARDA had 1,773 tubewells drilled from 1983 to 1989 and 3,111 washbores had been jetted. Similarly, the summary reported that a commercial arm of KNARDA sold about 43,582 2" and 3" water pumps to fadama farmers. Because the washbore technology is simple and farmer demand is high, local people developed their own ways of jetting washbores around the Rano area.

Our adaptive research has proven that high yields are possible for crops grown under irrigation — yields that may be replicated or exceeded by smallholders. It also has tested yields of different varieties under local conditions; the table below indicates yield potential of checks versus improved varieties during the dry season.

Costs and Returns From Small-scale Irrigation Schemes. Yield increases are important in measuring new technologies aimed at increasing food production. Also important are favorable returns as compared to costs; farmers must make a profit if they are to adapt and keep using the technology.

Costs. While government-controlled irrigation schemes usually require a large investment to build permanent infrastructures, the individually controlled scheme requires little capital. Cost items under the individually controlled scheme may include the cost of a tubewell or washbore, pump, and operation and maintenance cost.

However, over the years, the acquisition cost of washbores rose dramatically from a minimum of about =N=250 in 1983 to =N=600 in 1989. Similarly the tubewell started at =N=800 in 1983 and rose up to =N=1750 in 1989. Further, 2" pumps rose from =N=350 in 1983 to =N=2000 in 1989.

In addition to the capital costs — usually depreciated over time — production costs vary with locality, types of crops grown, system of production (improved or traditional), and availability of inputs at an affordable price.

Returns. Farmers normally measure returns in terms of gross input and output relationships. The incremental increase in yield can be substantial. And irrigation reduces the risk of crop failure. The associated benefits of

Yield potential of checks versus improved varieties during the dry season

Crop	Variety	Yield (kg/ha	Percent increase	Remarks
Garden pea	Onward	680	-	Rano
	Early onward	2,200	223.5	
Onion	Smaru composite	3,840	-	Rano
	Ex-Gayanawa	4,096	6.7	
Tomato	T1-221	9,333	-	Dambatta
	T1-205	16,444	76.2	Heat tolerant trial
Wheat	Siete Cerros	2,613	-	Zone III
	Pavon 76	4,013	53.6	KNARDA

Source: KNARDA Dry Season Adaptive Research Draft Report, June 1988-89.

increased irrigation may include increased food production, more rural employment, and lower prices of commodities produced. However, realizing the full potential of irrigation requires, not only a good water supply, but also complementary agricultural and institutional support, meaning improved agricultural research and extension.

Government subsidies on major inputs (fertilizer, pumps, and tubewells or washbores) to lower production costs would attract more farmers to irrigate their crops. This was seen under the Kano state government's accelerated wheat production program in the late 1980's.

Problems and Constraints in Small-Scale Irrigation

Careful, purposeful planning and diligent execution of programs usually yields success. We found several problems and constraints in developing small-scale irrigation that often elude good planning and execution. They include the following:

Inadequate and costly input. Supplies of inputs such as fertilizer, water pumps, pesticides, and herbicides are inadequate and expensive.

During the early phase of the authority's program, farmers were able to go to the agricultural supply company and buy most of their inputs at a reasonable cost. As the benefits of the program became known, the essential inputs became scarce and higher priced.

Water pumps, pesticides, herbicides, and fertilizers all are being hoarded. The urea supply for farmers has been choked by new competition — urea increasingly is being used for non-agricultural purposes; for example, in textile manufacturing and in tanneries. These new users buy large quantities of urea fertilizer at prices smallholders cannot afford.

Adulterated pesticides and herbicides. Many of the chemicals farmers need and buy in the imperfect markets are adulterated, have passed their expiration dates, and are surprisingly expensive.

Shortage of pump spare parts. Reliable and genuine spare parts for the petrol and diesel water pumps are lacking and, where found, are too expensive for smallholders.

Lack of land preparation equipment. The collapse of tractorization and lack of suitable and sustainable technology for preparing land for crops usually delays planting, resulting in low yields.

Competitive farmer-herdsmen relationships. As earlier indicated in this paper, fadamas were generally considered as grazing reserves before the expansion of small-scale irrigation. Conflicts often occur between arable farmers and Fulani herdsmen over the use of rural fallow lands, ownership of farm by-products, and access to water points.

Although conflicts seldom arise between the indigenous Fulanis and farmers, serious clashes have occurred between the nomadic Fulanis from Niger, Mali, and Chad and indigenous arable farmers. Unless this is settled, conflicts may escalate because of a lack of good grazing in the countries from which the nomadic Fulanis come. This may cause more herds to enter Nigeria's fadamas.

Inadequate credit facilities. Smallholders are finding it increasingly difficult to adequately finance their production needs, particularly under the stringent structural adjustment

program. Commercial bank credit facilities usually are beyond the farmer's reach and, in some cases, interest rates —at 30% to 35% — are high and formidable.

Lack of marketing strategies. Demand for exotic vegetable species in the urban areas are far away from major producing areas. Getting the produce from where it is produced to where it is consumed is a serious constraint. Also, farmers' inability to sell their products during glut periods usually leads to low prices and serious loses or decomposition of perishable commodities.

Lack of access roads in Fadama areas. Most of the fadama areas are remotely located with poor or non-exist feeder road networks. This prevents farmers from transporting their crop produce to urban markets. Lack of roads also curtails delivery of large qualities of inputs.

Lack of crop-handling and -processing facilities. Because of the perishable nature of most fadama produce, coupled with a lack of handling and processing facilities near the site, substantial losses usually occur. Losses of tomatoes and pepper can be as high as 30% to 50%.

Lack of cooperative groups. In Kano State, there is no known registered cooperative group with an interest in fadama production. Farmers usually operate as individuals; on rare occasions they form groups to hire trucks to transport their commodities to urban markets in the south.

Lack of trained irrigation engineers. Particularly in government projects, there are too-few trained irrigation engineers so expatriates have to be recruited to design and implement the engineering work required.

Future Development Strategies

In spite of the problems and constraints, small-scale irrigation will continue to expand and remain profitable for farmers for the foreseeable future. Further research is needed to understand and surmount the problems and constraints.

At the impressive rate that small-scale irrigation is developing in Kano State, the potential may be exhausted in 10 to 15 years. Therefore, where it is possible and economically feasible, small-scale irrigation may be used on upland farms throughout the year to make possible both rainfed and irrigated production.

Future development strategies should consider, among other factors, the following:

- Assessing the effect of irrigation activities on the environment, particularly on biodiversity (fisheries, wildlife, and grazing reserves), including ways to improve biodiversity.
- Increasing input supplies at an affordable cost.
- Forming cooperative groups to help farmers obtain credit and maintain profitable production.
- Promoting animal traction and suitable land-preparation implements.
- Establishing a capable adaptive research unit to work closely with research institutes to find and test suitable irrigation crops and practices and distributing the seed and technology to farmers.
- Training suitably qualified people in irrigation engineering.

World Bank Financing is Expected. As a follow-up to the just-completed fadama irrigation program, another World Bank loan has been negotiated. It will finance a new project called National Fadama Development Project (NFDP). Kano State is one of five states to benefit from the 4-year program. The salient features of NFDP include

- providing access and fadama roads
- privatizing washbore and tubewell drilling
- forming a Fadama Users Association to manage and sustain the production activities in fadamas
- building crop-processing shades and cold storage
- recovering the full cost of irrigation development from the participating farmers

In keeping with the World Bank requirement, the Federal Agricultural Coordinating Unit (FACU) sponsored an environmental assessment in the five benefiting states. The study examined the effect of fadama irrigation on other users of the environment. It covered fishery development, wildlife, pasture development, soil and water conditions, social conflicts (farmer-herder), and patterns of water-borne diseases.

FACU organized a post-study workshop in August 1992 in Kano, attended by policy-makers and technical experts from the implementing states — Bauchi, Sokoto, Jigawa, and Kebbi as well as Kano. The study and the workshop concluded that the project would not have a serious adverse effect on the environment.

The workshop participants came up with useful recommendations, such as putting aside 30% of irrigable land for biodiversity and creating an institution to resolve social conflict. Some of the recommendations already have been incorporated in our development programs.

Conclusion

Small-scale irrigation is an age-old technology, which has helped increase food production and incomes of smallholders. Exploitation of fadama-based irrigation production still is limited by lack of funds, inputs, and innovative technologies.

An agricultural development program by the Government of Nigeria is required to help smallholders further exploit the abundant fadama resources. Similarly, other organizations interested in helping smallholders increase their food production will supplement the government efforts and should be encouraged.

In addition to small-scale irrigation, livestock, fish, wildlife, and agroforestry activities that share the available resources must be considered in the context of sustaining the environment and biodiversity. Therefore, irrigable potential should be developed only after studying the extent to which other economic activities depend on the environment for survival. In other words, the environment must be protected from any cumulative adverse effects of development activities. We should adopt a multidisciplinary approach to future development of fadama resources.

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Strengthening the Institutional Foundations for Modern Agriculture in Sub-Saharan Africa

Christopher R. Dowswell
Director for Program Coordination
Sasakawa Africa Association

In 1986, the first Sasakawa Global 2000 (SG 2000) projects began working with Ministries of Agriculture and farmers in selected sub-Saharan African countries to treat the causes of declining per capita food production. Since then, we have worked with several thousand frontline (working in the field) extension officers and more than 200,000 farm families to introduce higher-yielding technology for the staple food crops.

The overwhelming proportion of these farmers are small-scale producers cultivating less than 2 ha of land. Most are in a pre-green revolution stage of production, relying on low-yielding traditional technologies. Most would not be classified, however, as being among the poorest farmers. Indeed, many have the potential to become commercial producers, cultivating 5 to 10 ha, using appropriate, science-based agricultural technologies.

The SG 2000 Impetus. SG 2000 scientists and managers believe that farmers on Africa's best lands should use modern research information and higher input levels to produce more food. We reject the contention of some agriculturists that small-scale food producers can increase their productivity and be lifted out of poverty without the use of appropriate purchased inputs, such as improved seed, fertilizer, and crop protection chemicals.

Over the past two decades, mounting population pressures have broken down traditional systems of shifting cultivation to restore soil fertility. As a consequence, even though crop yields remain inadequately low, soil resources are rapidly being degraded and croplands are becoming choked by invasions of noxious weeds.

To help overcome these alarming environmental and food-production problems, agriculture must be intensified on lands that can stand more-intensive cultivation and should be decreased in the more-fragile ecologies.

We believe that, unless African agriculture can be transformed to offer more attractive economic opportunities, increasing numbers of rural youths will abandon the land and migrate to the cities. They will leave behind low-yielding food-production systems that are short of labor and incapable of feeding the growing populations.

SG 2000 project leaders dream of a commercial African agriculture made up mainly of small- to intermediate-sized family farms that use modern science-based technologies. These farms are clustered around bustling villages and towns that provide access to schools, potable water, and health facilities, as well as

markets and stores. Agribusiness enterprises facilitate the commerce of these communities, supplying farmers with the products and services they need to run the modern and productive commercial food producing sector that we envision.

Overview of the SG 2000 Agricultural Program

SG 2000 project staff work with Ministries of Agriculture in cooperating countries to mount dynamic and extensive technology transfer campaigns. We focus our technology transfer work on production environments that generally receive more than 700mm of annual rainfall or that have irrigation. We believe these lands are best suited for intensified food production.

SG 2000's support to Ministries of Agriculture takes several forms, including

- assigning one or two internationally recruited senior advisors to each country project
- supplementing budgets of agricultural extension services to facilitate field program operations and training activities
- supplying some bicycles, motorcycles, and pickup trucks — supporting the operation and maintenance of these vehicles — to improve mobility of field supervisors and frontline extension officers

A national planning and coordinating advisory group in each country — linked to the Ministry of Agriculture — helps to set crop, geographic, and target farmer-group priorities. Extension supervisory personnel at the regional (departmental) and district (prefecture) levels are responsible for managing most of the field activities.

SG 2000 ensures that these funds are properly used by putting suitable management information systems in place to ensure that SG 2000 funds are properly used. Databases are maintained on the selection of farmers, distribution of PTP inputs, range of PTP yields, and recovery of input loans.

National extension leaders frequently comment favorably on the flexibility of SG 2000 project funding; each country's project budget is reconsidered each year and, within funding limits, is adjusted to address better the project's changing needs and opportunities.

By contrast, many other donor organizations disburse funds — whether grants or loans — according to rigid budgetary plans that were developed before the project began, even if the priorities and needs have changed. Lack of budgetary flexibility sometimes results in purchase of capital goods — such as trucks, equipment, and buildings — that experience shows a country cannot adequately maintain and operate.

SG 2000 Approach to Technology Transfer. Working with national counterparts, SG 2000 has developed a simple, yet effective, approach to transferring agricultural production technology. The centerpiece of this approach is the farmer-managed technology evaluation and training plot, sometimes called the Production Test Plot (PTP), the Management Training Plot (MTP), or the Extension Test Plot (ETP). I will use the PTP terminology since this is the name used in Benin.

Ministry of Agriculture/SG 2000 field demonstration programs start by introducing improved technology for two or three of the most important food crops for which proven and markedly superior technology is available. Today, improved technologies are being demonstrated in maize, wheat, sorghum, grain legumes, cassava, and rice. In addition, we are demonstrating a green manure crop,

commonly called velvet bean (*Mucuna utilis*), to help farmers improve soil fertility and control weed invasions.

The recommended technological packages include

- improved varieties to be planted at more-optimum plant populations
- moderate and appropriate use of fertilizers and organic manures
- improved cultural practices to better control weeds, insects, and diseases

Most of the improved varieties are based on elite germplasm developed by public sector international and national agricultural research centers. Similarly, crop management recommendations are based on the work of these research organizations.

SG 2000 devotes a quarter of its country project resources to training-related activities. Although small-scale farmers are generally aware of improved seed, fertilizers, and so forth, they often lack the detailed knowledge they need to take full advantage of these inputs. In-service training, which follows the growing cycle of each crop, is given to frontline extension workers who, in turn, provide training to participating farmers. PTP farmers, as well as neighbors, generally get this training through organized groups, using the plots in the vicinity as the teaching sites.

Farmers who participate in the joint Ministry of Agriculture/SG 2000 field testing and demonstration programs are assured that they will receive — for 1 to 2 years — timely technical training and the necessary inputs to put into practice the entire package of recommended technology. To add economic reality to this test, the PTP inputs, which cost US$ 40 to 70 (depending on the crop and country), are loaned to the farmer, who agrees to repay the debt after harvest.

Depending upon the crop, we think that production test plots should be between 0.25 and 0.5 ha; this is large enough for the farmer to assess clearly the labor and input requirements of the recommended technology. Moreover, with this larger plot size, the farmer also gets immediate and clearly measurable benefits — usually an additional ton or more of product; this motivates the farmer to adopt the technology on a continuing basis.

Protecting the quality and value of crops after they are harvested is the other side of the production coin. SG 2000 is working with Ministries of Agriculture to help train farmers — and extension workers — in postharvest and grain-storage technology, including the construction of improved on-farm grain-drying and storage structures, and in the control of diseases, insects, and animal pests in stored produce. These postharvest technologies are based on national and international research findings and include modifying traditional structures and practices.

We also have made several thousands of small grants to PTP farm families who cooperate with extension officers in applying the improved postharvest technology, to serve as demonstration sites for their neighbors.

PTP Input Supply is Important to Success. Farmers consistently say that getting the recommended PTP inputs on time, and being trained in using them, are the most attractive and distinguishing features of the SG 2000 field demonstration program.

Frontline extension officers involved with the SG 2000 projects see to it that PTP inputs are delivered to participating farmers on time, handle the credit arrangements, and recover the loan value of these inputs after harvest. However, the project supplies inputs only for a limited time and only as a way to train farmers to use the new technology.

Providing inputs needed to grow a PTP has been controversial. Many extension experts think that frontline staff should not be responsible for distributing inputs to farmers and for loan repayments, but rather should focus their efforts on transferring technical information. They fear that extension officers might compromise their credibility with farmers if they become loan collectors. Further, they are concerned that the money collected in input loan repayments might be misappropriated. And they feel that the selection of PTP farmers could become skewed toward farmers that are relatively better-off from whom loan collection might be easier and safer.

In asking extension workers to be responsible for input delivery and loan repayment, we are not advocating that extension officers become commercial input distributors nor money lenders. Rather, we justify their help in supplying inputs to PTP cooperators on two grounds:

- We want the farmer to use the full package as recommended and he needs to apply several of the components at just the right time if he is to get the most benefit from the new technology.
- In being responsible for repayment of the input loans to PTP farmers, the extension workers assume some of the risk associated with the recommended technology.

Obviously, this addition to the extension workers' normal responsibilities would be unnecessary if input supply systems and other prerequisites for modernizing agriculture were well developed in sub-Saharan Africa. But since they are not, we believe that asking extension officers to assume broader responsibilities is necessary to transform small-scale food production.

A New Approach is Being Tried in Ghana. The Ministry of Agriculture of Ghana has arranged for inputs to be provided to 3,000 extension demonstration plots (ETPs) on credit. The procedure works as follows:

- Some 10 to 15 farmers agree to associate themselves in a formal group to grow an ETP.
- The extension officer helps the group complete a simplified loan application, which includes a photograph of each member.
- The extension officer then accompanies the group's leaders to the local office of the agricultural development bank (ADB), where the ETP input loan request is reviewed for completeness and approval.
- Once authorized, the farmers take a voucher to a private sector input-distribution company, selected through a bidding process by the Ministry, and the company dispenses the required inputs to the farmers.
- ADB pays the company for the inputs it distributes to ETP farmers, and the group pledges to repay its loan to ADB after harvest.

Extension officers do not handle input distribution nor loan repayments, although they monitor and facilitate the process.

ADB is responsible for teaching farmers how to obtain and use effectively agricultural production credit; this justifies its participation in the Ministry's ETP program.

Growing the ETP under the technical supervision of the extension service improves the ADB's chances for its loan repayment. Also, by working with groups of farmers, the bank's per-borrower transaction costs are reduced.

If recovery rates stay above 80%, ADB should be able to continue providing input credit to ETP farmers.

Other Approaches are Being Explored. SG 2000 staff members are exploring other avenues for ensuring that farmers growing test plots have access to recommended inputs. One alternative is to promise to deliver the required inputs to the farm gate if farmers agree to pay upon timely receipt of them. Another is for the extension service to pay for one of the less expensive components, such as the improved seed, if the farmer agrees to pay for a more expensive component, such as the fertilizer.

Typical SG 2000 Project Cycle. We are running a 10-year project cycle, with two distinct phases in staffing and program activities.

Phase one usually lasts 5 to 6 years and includes the period of major activities and budget outlays. Programs are managed by one or two expatriates, supported by locally hired administrative and technical personnel. As I mentioned earlier, most human resources are contributed by cooperating Ministries of Agriculture, with SG 2000 helping finance the purchase of vehicles, equipment, and inputs, as well as supporting field program training and operational costs.

Phase two typically lasts 4 to 5 years. During this period, the Sasakawa Africa Association (SAA) continues to support selected phase one activities, but at lower intensity; these operations are managed by local-hire professional and technical staff, supervised by senior SAA administrative and technical staff from headquarters.

This two-phase project cycle offers many advantages. The following are three:

- It permits a relatively long period of direct SG 2000 involvement within a project country.
- It relies increasingly on national personnel to do the job.
- It is cost-effective; we estimate that about three fourths of a typical SAA country budget supports local field operations.

Of course, the project cycle is built upon successful cooperation in the earlier years and its future depends on the continuing availability of funds.

The Emerging Role of Private Enterprise. After three decades of disappointing performance by public sector organizations, many people are looking to the private sector for new leadership. Experience shows that private enterprise is more effective in delivering improved technology to African farmers than has been the case with parastatals.

We expect private sector companies to increase production, especially as competition develops. Of course, governments must create a conducive and enabling regulatory environment in order for private enterprises to mobilize the capital they need to develop vibrant agribusinesses.

Two kinds of products are especially needed — fertilizers and seeds.

Without increasing use of fertilizers, Africa will not be able to feed herself, much less make agricultural development the engine of economic growth it can and must become. Although we strongly support privatization and liberalization in agricultural markets in sub-Saharan Africa, we also believe that without some subsidy on fertilizer (20 to 30%), at least for the next one to two decades, the present small commercial fertilizer demand will not expand rapidly enough to make investments in fertilizer delivery systems attractive for entrepreneurs.

The private sector should be encouraged to invest in and facilitate seed production and distribution. But national seed industry policy needs to recognize the role of the public sector in funding plant breeding research, breeder and foundation seed production, and seed certification and quality control; they all are important government activities.

Helping Build National Capacity

Viable governmental and non-governmental agricultural development organizations that are staffed by well-trained and experienced personnel are necessary for the transformation of African agriculture. Yet national institutional capacity building has been one of the most disappointing chapters of African development.

The excessive reliance in the past on expatriate staff to manage and implement development projects is increasingly being seen as one of the central reasons why institutional capacity building has progressed so slowly in Africa.

In 1988, General Olusegun Obasanjo commented on this situation during the inaugural program of the African Leadership Forum, which chairs. He said:

> Africa is strewn with the wreckage of failed economic policies — for the most part, policies devised by outsiders from outside and thrust upon us. Yet despite these failures, advising African governments continues to be a roaring industry and these foreign experts do not come cheap...At any given time, sub-Saharan Africa alone has as many as 80,000 of these experts. Not altogether surprisingly, more than half...of the assistance aid we receive goes to finance these advisers. Here too, is it not about time we looked more to our own universities and our intellectuals?; first to come up with solutions to some of our most clamant problems; but having done so, also to help enforce action without which all thought is empty. We will all fall under a far-reaching condemnation at the bar of history if, in our various walks, we do not prove ourselves equal to the challenge of the hour.

Recently, World Bank Vice President for Africa, Edward K. Jaycox, in referring to the problem of building African institutions and developing her human resources, cited the large number of expatriates working in official development assistance in Africa as part of the problem of developing African institutions.

Upgrading the Technical Skills of Extension Staffs. Beyond the SG 2000 emphasis on using and training local people in its country projects, SAA is strengthening the skills of extension staffs through fellowships. This initiative is based on the following facts.

- Many of the so-called environmentally friendly technologies being developed by agricultural scientists today are knowledge-intensive. It will be easier to transfer these technologies and get them adopted if agricultural extension programs are strengthened and if rural education systems are improved.
- Unless the technical competence of frontline extension staff is vastly improved in sub-Saharan Africa, spreading such modern practices as adopting integrated pest management and using crop rotations, organic manures, and residues to maintain soil fertility are unlikely. They will not spread much beyond the research station.

In light of these facts, the SAA board of directors in 1991 approved a new program that provides fellowships for extension supervisory and frontline technical staff to pursue formal university degree training, primarily at African universities, and supports the upgrading of the quality of university training in agricultural extension.

This extension-strengthening initiative is called the Sasakawa African Fellowship and Extension Education Enhancement (SAFE) project. It is being implemented in collaboration with the Winrock International Institute for Agricultural Development, a leader in human resource development and enhancement of agricultural university training. The collaborating institutions expect the SAFE program to make a significant impact in the future.

By the end of 1993, SAA, through its SAFE project, will have awarded to individuals some 15 BSc and MSc fellowships for study at African universities and three PhD fellowships to study overseas. SAFE also is providing financial assistance and other resources to several universities to strengthen the agricultural extension curriculum and field practicum programs. Our support is helping another 20 to 25 mid-career extension officers, financed mainly by their governments, to pursue BSc and MSc degrees.

Strengthening university programs. SAFE is working with the University of Cape Coast in Ghana, which recently established a new BSc program for mid-career extension staff with either certificate or diploma credentials. The new curriculum was developed in consultation with extension leaders, seed producers, and farmers. It is practical and well-suited to upgrade the skills of these mid-career professionals.

SAFE also is assisting the University of Ghana, Sokoine Agricultural University in Tanzania, and the University of Benin in Cotonou, to upgrade their curricula and renew their library collections on technology transfer methods. In the future, SAA expects to lend its support to other agricultural universities in SG 2000 project countries.

Some Lessons Learned

The Sasakawa-Global 2000 Agricultural Program in sub-Saharan Africa has demonstrated several important points:

- First, for areas with rainfall above 700 mm per year, improved technology is presently available that can double and triple yields on most farms.
- Second, small-scale farmers in these environments are ready and eager to adopt improved technologies, provided that inputs are available on time, a market exists for the increased production, and there are economic incentives to increase production.
- Third, agricultural extension services, when provided adequate transportation and budgets to operate farmer-oriented field testing and demonstration programs, can become effective agents for technological change.

We believe that, by associating in a farmers' organization, small-scale producers have a better chance to succeed in commercial agriculture. Technical and economic information flows more easily through organized farmers' groups and farmers are more likely to gain price advantages through collective action.

Unstable currencies and high inflation rates slow agricultural modernization. For small-scale farmers to be able to increase their productivity, input and output prices need to be relatively stable and predictable and, again, high enough to enable farmers to make a profit.

Unfortunately, raising yield levels on very small farms is probably not enough to bring about significant agricultural development. Rather, small-scale farmers must find ways to cultivate larger areas. To expand average farm size, most resource-poor farmers will need to move beyond human power. In most cases, the

jump to tractor power costs too much. Where bullocks can be kept in good health, animal traction using improved steel implements is the next logical step. However, this option is not available in areas where the tsetse fly is still prevalent.

Another option might be minimum-tillage land preparation systems; these will require using safe herbicides for weed control, such as the glyphosates. By adopting minimum-tillage systems, most resource-poor farm families can probably double their average farm size without adding animal or motorized mechanical traction systems.

Summing Up

Just to maintain today's often-inadequate dietary standards in sub-Saharan Africa, food production must be doubled over the next 20 to 25 years. Urban food demand will grow rapidly; current projections point to a five-fold increase.

The battle to keep total food supplies expanding faster than population in sub-Saharan Africa will continue to be a daunting one. If Africa is to feed herself, small-scale food producers need access to science-based agricultural technology. There are formidable obstacles to developing adequate systems for delivering improved seeds, fertilizers, and crop protection chemicals, and for providing vital services, including credit, grain marketing, and storage.

A combination of biological factors constraining yields must be overcome in an efficient and orchestrated manner. Principal among these factors are:

- restoring and managing soil fertility
- developing and using improved varieties that combine high genetic yield potential with improved disease and insect resistance and that tolerate environmental stresses
- improving crop management practices, including integrated pest management strategies

Some agricultural experts — especially from rich countries — often romanticize the life of the small-scale food producer and ignore the pressing realities imposed by a rising population.

Grassroots systems for delivering technology probably will be deficient for some time. Eventually, the private sector should play an important role in supplying inputs. In the meantime, agricultural leaders need to continue to make public sector organizations that supply inputs and market grain more effective.

Government leaders must not duped into believing that African agriculture can satisfy future food requirements and serve as the engine of economic growth by continuing to rely on traditional production systems. Nor should researchers place too much faith on obtaining near-term production impacts from technologies that require sophisticated extension communication and management skills to disseminate them among farmers.

Over the past 7 years, SG 2000 has been transferring technology to small-scale farm families who have grown more than 200,000 production test plots. Virtually all of these cooperating farmers have shown that they are willing, able, and eager to adopt the high-yielding, fertilizer-responsive, improved-seed technologies being recommended for maize, wheat, cassava, and grain-legume crops.

The inevitable question asked of any externally-funded development assistance project is: will host-country organizations continue jointly implemented programs once project staff leave and financial support ends?

In the case of the field-testing program promoted by SG 2000, it is unlikely that national governments will — or can — adopt the full program, given their budget limitations. Recently, African governments have made structural adjustments that are resulting in significant reductions in Ministry of Agriculture personnel. National extension services, which invariably have many employees, also are undergoing substantial reductions.

Most of the personnel cuts are in frontline staff with the lowest levels of formal training in agricultural production. These staff reductions, however, are not resulting in appreciable increases in operational budgets per staff member; rather, extension budgets are being cut across the board. In addition, the budgets in other key public agricultural sector organizations — especially national agricultural research services — are inadequate and shrinking.

Therefore, we believe that continuing external support will be needed from governmental and non-governmental organizations — probably for several decades — if this dynamic technology transfer program is to be sustained.

Winrock's On-Farm Productivity Enhancement Program in West Africa

Pierre Antoine and Francis C. Byrnes*

Millions of smallholder farmers of sub-Saharan Africa experience food shortages during part of each year. This is a reality of their lives. Most of these farmers live in places not easily reached by roads or mass media. They lack access to improved seeds, fertilizers, and other needed inputs, either because these inputs are unavailable or because they lack funds or credit to buy them.

Since, they lack access to seeds, these small farmers do not benefit from many of the results of agricultural research and improvements in technology that are bred into the seeds of new varieties. They use limited amounts of other yield-increasing inputs and they farm at a subsistence level. As a consequence, food crop yields are decreasing and soil fertility levels are declining in sub-Saharan Africa.

These are some of the reasons that several international organizations designed the On-Farm Productivity Enhancement Program (OFPEP).

OFPEP's activity focuses on increasing farmers' access to good seeds and helping them understand how to conserve and build soil fertility. Practices proposed are within the small farmer's capacity and they require few external inputs that are subject to the vagaries of supply or cost.

The program's principal goal is to improve the nutrition, incomes, and well being of small farmers in targeted countries. Another goal is to encourage and help some farmers produce and sell improved seed in their local areas.

The OFPEP Approach and Strategy

OFPEP's approach is participatory and collaborative.

- It is participatory in that farmers tell program workers what constraints hamper their progress — such as poorly adapted varieties, low nutrient levels, and erosion — and what assistance they would welcome from the program.
- It is collaborative in that almost all activities are implemented through international or national locally based nongovernmental organizations (NGOs) and the U.S. Peace Corps.

Three basic premises underlie the program approach: (1) smallholder farmers know more about agricultural production than they realize; (2) increasing smallholders'

* Director, Africa and Middle East division, and Senior Associate, respectively, Winrock International Institute for Agricultural Development.

consciousness of their knowledge can help them increase their farm's productivity; and (3) farmers can increase their productivity by using locally available technical inputs.

OFPEP integrates the technology it introduces with the social, cultural, and educational conditions on local farms. The program tailors its approaches to the farmer's resources and goals. Farmers are partners, not just observers, in the program's activities at the farm level. OFPEP offers farmers technologies that are economically sustainable and environmentally sound and that increase productivity without the heavy use of purchased inputs.

In implementing the OFPEP program, staff members

- identify local organizations involved in agricultural activities that could benefit from OFPEP assistance
- discuss traditional seed production and soil management systems with local farmers and extension agents, and develop a database to store the information gathered, including division of labor and decisions by gender
- identify appropriate and proven technologies — such as varieties being planted and crop management techniques — that are adapted to local conditions
- develop technical training programs for NGO, Peace Corps, and extension staffs, and conduct demonstrations (not trials) with farmers
- review results and farmers' reactions to the demonstrations and modify activities accordingly
- develop partnerships with national, regional, and international agricultural research institutions, and other links with sources of technical assistance, to support the program's scientific and technical foundations

The program staff regularly produces training materials and manuals and publishes a newsletter in English and French.

Target Countries and Implementing Institutions

During the first 5-year phase in West Africa (1987-1992), the program focused on seed-related activities, such as seed multiplication and storage, and cropping techniques, in Senegal and The Gambia under the heading of the On-farm Seed Project.

First phase activities in East Africa (1989-1992) were limited to promotion of biological nitrogen fixation and production of rhizobium inoculum in Uganda — the Biological Nitrogen Fixation/Legume Management Outreach Pilot Project.

In the program's second phase (OFPEP, 1992-1997), seed and soil-related activities initially were integrated in Senegal, The Gambia, and Uganda. Additional countries, such as Kenya, may be added as funding becomes available.

Several Institutions Implement the Program. Under the present organization, Winrock International Institute for Agricultural Development (Winrock) provides overall leadership and administration of OFPEP from its headquarters in Morrilton, Arkansas, USA.

The Center for PVO/University Collaboration in Development (the Center), headquartered at Western Carolina University, in Cullowhee, North Carolina, USA, coordinates the program and disseminates information.

Specific institutions are responsible for coordinating and implementing activities in the field: Winrock in Senegal, Save the Children Federation in The Gambia, and Agricultural Cooperative Development International in Uganda.

Technical assistance staff based in Senegal (Winrock and the Center) also support technical work in The Gambia. Another Winrock staff member, based in Kenya, supports technical work in Uganda.

Mississippi State University, through the Center, provides technical advice in seed technology.

Steering committees or advisory councils operate in the USA and in each participating country.

There Also are Support and Partner Organizations. A variety of institutions, especially the member institutions of the Center, provide technical contributions and/or research support. The Nitrogen Fixation by Tropical Legumes, Tropical Soils Collaborative Research Program, Nitrogen-Fixing Tree Association, Rodale International, Uganda's Makerere University, and the Senegalese Institute for Agricultural Research (ISRA), also provide technical and/or research support.

Major partners for field activities and extension work with farmers include the Peace Corps (Senegal and The Gambia), World Vision (Senegal), Christian Children's Fund (Senegal), Catholic Relief Services (Senegal and The Gambia), Freedom from Hunger Campaign (The Gambia), and Action Aid (The Gambia).

The Program Uses Few Staff. The program employs the equivalent of 5.5 staff in the three targeted countries. The Peace Corps and partner NGOs provide at least 30 person years of extension staff assigned to program tasks each year.

USAID provides about 75% of OFPEP's Phase II (1992-1997) funding. The remainder — a 25% match — comes from the implementing institutions.

Producing Seeds and Improving Agronomy

OFPEP builds on the On-farm Seed Project program experience in Senegal and The Gambia. Both differ from most seed production programs in developing countries in that their national seed programs rely heavily on the public sector and do not cater primarily to smallholder farmers. Instead, OFPEP concentrates on promoting, at the small farm level, seed of improved varieties, simple seed-selection and storage practices, and basic agronomic practices.

OFPEP Helps Produce Seeds and Introduce New Varieties. The program focuses on rice, millet, cowpea, and, to a lesser degree, groundnuts. Unlike the self-pollinated crops of rice, cowpea, and groundnuts, the cross-pollinated grain, millet, requires special precautions to maintain genetic purity.

In areas where traditional varieties of millet remain best suited to local conditions, the project promotes cropping techniques to improve yields. Staff leaders place the plots for producing millet seed in the middle of a millet field, which minimizes cross-pollination with other varieties being grown in the community and is useful when introducing a new variety. They plant one millet seed per hill, and select seeds from plants that are high tillering, free of disease, and have uniform and large heads.

In northern Senegal regions where traditional varieties no longer are suitable because of lower rainfall, the earlier maturing, improved varieties have been accepted readily by farmers. Farmers in those regions also adopt quickly improved cowpea varieties for both grain and forage use.

Several improved rice varieties introduced in the Kolda region of Senegal and in The Gambia have been accepted by women farmers. Those varieties, developed by and

and with seed obtained from ISRA, are photoperiod insensitive, early maturing, short statured, and resist they rice blast.

Staff Promotes Improved Agronomic Practices. The program staff successfully promotes direct seeding of rice in rows, using animal traction. Farmers are using locally-manufactured seed drills or hand-pulled row markers. Row planting lets farmers kill weeds at an early stage.

The introduction of animal traction in rice fields has directly influenced gender roles. Although, in some areas, producing rice traditionally has been women's work, and using animal traction has been men's work, a high percentage of men now are willing to use their animals to help the women plant rice.

Other improved practices for rice include selecting the best varieties, using cattle manure, and where rice is started in seedbeds, transplanting seedlings at the right stage of development.

In northern Senegal, OFPEP workers have emphasized preparing the land before planting millet and applying mineral fertilizers (14-7-7). This practice increases yields as compared with the traditional practice of applying fertilizers after the crop emerges, without any land preparation.

Training Peace Corps and NGO Staffs

The program provides direct training, technical assistance, and other support services to the Peace Corps and several NGOs working in agricultural development programs in Senegal and The Gambia.

OFPEP has trained more than 150 Peace Corps volunteers in Senegal and The Gambia. Training focuses on managing production of improved rice varieties (seed selection, agronomic practices, and nursery management) and, since 1992, on soil management practices — including the use of agroforestry species — in The Gambia and the surrounding region in Senegal.

Although most volunteers received generalist's training in universities in the USA, their technical training in the program workshop makes them more effective in helping local farmers accept improved varieties and agronomic practices. Peace Corps volunteers have organized 250 demonstrations in 60 villages.

Training Has Yielded Positive Results. The program has trained staff of several NGOs, with positive results.

- World Vision has an integrated water/agriculture/health program reaching about 150,000 people in more than 200 villages of northern and central Senegal. Twenty five World Vision staff and 40 of their lead farmers — who are responsible for millet and cowpea demonstrations in 35 villages — have been trained.
- Following training under the program, Christian Childrens' Fund village staff now are able to monitor the production of millet seed in farmers' fields in about 20 villages of central Senegal.
- The program assisted Catholic Relief Service in its program of seed/cereal stores construction in more than 250 villages in Senegal during 1990 and 1991.
- Since 1988, the program assisted Save the Children Federation in an agricultural program focusing on introducing new rice varieties, animal traction, and seed multiplication in 24 villages in The Gambia with a population of 10,000 women farmers. The number of rice contract growers went from 25 in 1990 to more than 150 in 1992 in that region.

- Collaboration with the Freedom From Hunger Campaign, operating in another part of The Gambia, is similar to that of Save the Children Federation in terms of program support, results, and impact.

Numbers of Program Beneficiaries

The number of farmers benefiting from a program such as OFPEP is difficult to estimate given the domino effect of technology adoption, and the informal word of mouth spreading of technical messages. Bellow are the numbers of people trained and of beneficiaries — as well as the number of demonstrations conducted and observed — from 1987 to 1992, calculated by the team making the final evaluation of the On-farm Seed Project.

An official evaluation team estimated in 1992 that, when indirect beneficiaries are added to the total, at least 65,000 small farmers benefited from the OFSP project in Senegal and The Gambia from 1987 to 1992. Two-thirds of the beneficiaries appear to be women.

In planning and implementing OFSP and OFPEP activities, Winrock paid particular attention to gender analyses in four factors — labor, income, expenditure patterns, and resources of men and women. Winrock learned that division of labor and other factors between men and women varied greatly by area as well as by crop.

In Senegal and The Gambia, for example, depending upon local ethnic groups, both men and women may cultivate rice and millet, while women tend to be responsible for groundnut production.

Impact of the Program and Lessons Learned

The program's impact can be assessed better in terms of adoption rates and yield increases than in numbers of people trained or who come in contact with a program activity.

Table 1. Number of People Trained by OFSP and Direct Farmer Beneficiaries of Training.

	Senegal		The Gambia	
	Men	Women	Men	Women
Peace Corps	36	43	10	17
NGO Extension Staff	200	50	137	44
Government Extension Staff	60	0	54	6
Farmer Beneficiaries	11,340	5,600	4,400	15,500

Table 2. Number of Demonstrations Completed and Farmers Who Observed Demonstrations.

Type of Demonstration	Senegal			The Gambia		
	No.	Men	Women	No.	Men	Women
Rice	371	550	9,990	240	320	10,360
Millet	308	3,000	500	0	0	0
Cowpeas	145	3,000	500	50	80	1,020
Groundnuts	40	270	60	0	0	0

Adoption Rates and Yields Increase. Adoption rates of technologies proposed in workshops or demonstration plots are estimated to be at least 60% in the different project regions of Senegal and The Gambia, regardless of the partner institution associated with the technologies.

Yield increases in demonstration plots as compared to fields where traditional practices are used are generally between 10% and 50%. Rice seed sold within The Gambia, and millet and cowpea seed sold in central Senegal, presently amounts to about 15 to 20 tons annually. Although modest, those figures represent a huge improvement over the situation existing 5 years ago.

Farmer demand to participate in the program remains high: it generally doubles or triples the year after activities are initiated and continues to grow every year thereafter.

All of the partner institutions' field staffs estimate that yield increases in rice, cowpea, and millet translate into an average of 2 to 6 weeks of additional food per year for participating farmers' families.

Despite the progress some commercial companies have made in introducing and spreading the use of hybrids, particularly maize, most farmers in developing countries still save seeds from the current season's crop (whatever the specie) to plant the next.

Lack of commercial access to seed is a pervasive problem; few seed firms produce seed of open- and self-pollinating crops. Thus, farmers need to do a better job of selecting, saving, and storing seed. In spite of that fact, few extension services are prepared to promote on-farm seed selection, treatment, and storage. Most NGOs lack up-to-date technical information on seed technology, but many respond to training when it is available.

OFPEP's approach is successful because it is demand-driven and highly participatory. Some problems have arisen when staff have not taken the time to conduct baseline surveys to collect information regarding farmers' perceived problems, constraints, challenges, and desires. They were in too big a hurry to do something tangible. A participatory approach takes time and requires much listening and readjustment, but it builds a solid base for a long-term and successful program.

The Program Targets Smallholders. Unlike most seed programs in developing nations, OFPEP targets small farmers, rather than large farmers. The enthusiasm of small farmers to cooperate justifies the patience and effort involved in learning more about them and their needs. In fact, the demand for program assistance is much greater than the present program can provide.

It is essential in the participatory approach to avoid confronting farmers with a complex package of new practices. OFPEP makes sure that the message remains simple and contains farmer-friendly, proven technologies; its staff members do not expect the farmer to make drastic changes in his or her agronomic practices, but to do better than s(he) has been doing for years.

The program avoids establishing research trials and relies primarily on demonstration plots. Targeted farmers may not understand research trials, particularly when they see failures. Moreover, the level of cutting-edge technical expertise among NGO/Peace Corps collaborators is limited.

When new research is needed to support program findings or challenges, collaborating research institutions — not the program — carry out the trials. Collaboration with ISRA has been especially fruitful in that regard.

The ability to replicate activities from region to region, or from partner to partner, is no problem, provided the program maintains flexibility to adapt its services to regional needs or the mandate of each partner organization. Each NGO has unique needs and a specific focus. For some, emphasis is on soil management; for others, on seed production or storage; for still others, on agronomic practices.

Sustainability of the program is a key concern. Adoption rates are encouraging. New varieties and practices introduced to some communities are spreading to neighboring villages via informal contacts among farmers or farmer-to-farmer exchanges of seed.

Seed stock renewal is a serious concern, especially of millet, a cross-pollinated crop, and cowpea, a legume that is susceptible to insect damage.

Training Nationals Has a Long-term Payoff. Partner NGOs participating in OFPEP in Senegal and The Gambia are committed to long-term development work. As most of their staffs are nationals, training them has good potential for long-term payoff.

When the program ends, OFPEP partners must make sure all the mechanisms and contacts are left in place so that farmers will have continuing access to good quality source seed for renewing their basic stocks.

Developing a seed production network and rhizobium inoculant dealerships in each country — two of the longer term goals of the program — are difficult to accomplish in a few years. However, there is progress on both counts.

With seeds, the focus is on improving farmer-saved seed of subsistence crops. Seed surpluses, when generated, generally are brought in line with demand by barter and cannot be identified easily according to traditional economic indicators. Formal sales of millet and rice seed reported in Senegal, however, are encouraging signs of progress toward achieving the program's goals.

In the case of rhizobium and other soil amendments, proven, ecologically adapted technologies are difficult to measure. It will take several years before a solid awareness of what these technologies can offer is developed within participating communities.

One of the difficulties partners' staffs encounter in monitoring the program is the lack of hard data that quantify such factors as yields and adoption rates. Many observations (except those concerning demonstration plots) are qualitative or semi-quantitative at best.

The staffs of some partner institutions have limited interest, time, or skills to carry out precise surveys. Some participating farmers, for a variety of reasons, are not eager to share their yield results. Indirect impact assessment methods need to be more efficiently integrated into the program in the future.

The few failures recorded to date generally can be attributed more to ecological factors than to flaws in program design. Rainfall patterns have changed considerably over the past 20 years in Senegal and The Gambia. Some communities have been slow to realize that climate changes necessitate reconsidering traditional cropping systems or sequences, and perhaps abandoning the cultivation of some crops such as rice, which is not adapted to dry conditions.

In terms of financial efficiency, the program demonstrates that substantial results can be achieved with tens of thousands of participating smallholders by leveraging

existing resources and capitalizing on ongoing programs, while investing sums of less than $400,000 per country per year.

Acknowledgments and References

The paper draws heavily on comments and technical reports prepared by Mr. Tom Osborn and Mr. Alphonse Faye, chief of party and agronomist, respectively, of the OFPEP Winrock team in Senegal, as well as on the following documents:

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Institutional Development Challenges in Reaching Women Farmers

Joyce B. Endeley*

In Africa, women's farming systems are still characterized by hoe culture, low use of improved inputs (such as fertilizer and new seed varieties), indigenous practices, inadequate access to extension services and other agricultural institutions, and low productivity.

Yet, women farmers play a vital role in family food production and agricultural development. They constitute more than half the agricultural labor force in many African countries. As dominant actors in the traditional food sector, they are vital to alleviating food insecurity, which is a big problem in many African countries.

Only real commitment will get action-oriented programs for women farmers implemented. These include reaching women farmers with improved technology and providing the components that will assure adoption of the technology. That is easier said than done.

It is ironic that we still are talking about how to reach women farmers with improved technology almost two decades after women in development (WID) became a popular phrase and WID a well-known acronym.

Now, when Africa faces food insecurity, reaching women farmers with improved technology is not enough. They should be encouraged and helped to adopt and to sustain their use of improved, more-productive technologies.

Needed: Commitment to Women Farmers' Needs

Most experts understand that women farmers need help. However, this conviction is not backed by a strong belief that women farmers' contribution to national economies is significant enough to warrant much institutional effort and resources. Thus, we find rhetoric, lip service, and token gestures when the discussion turns to providing assistance to women farmers, their programs, and their projects.

Successfully interacting with women farmers requires commitments by institutions to work with then. Institutions need to (1) change their negative perception that men, and not women, are the important farmers; (2) change their approaches in working with women farmers; and, most important, (3) to design strategies that explicitly target women farmers.

If Africa is to rapidly transform its agricultural sector, its relevant institutions need to work with women farmers (both heads and non-heads of households) in all their capacities — as producers, consumers, marketers, and processors of agricultural goods.

* Senior Lecturer, University of Dschang, Cameroon

Experts agree that the existing gap in women farmers' access to technical knowledge — and to the components need to put it into use — can be closed. Technical knowledge, coupled with inputs such as fertilizer, improved seeds, credit, and better farm tools — can increase women farmers' productivity and household income.

There is a further benefit in providing improved technology to women farmers: the literature confirms the positive relationship between women farmers' involvement in agricultural development programs and improvement in Africa's agriculture.

Women Farmers Lack Institutional Support. Analysis shows that poor farmers (both men and women) with marginal resources generally lack adequate access to research, extension, cooperatives, credit, and input institutions. Women farmers comprise the majority of poor farmers in many developing countries. They face more constraints than poor men farmers in gaining access to institutional services because of

- beliefs that men are the important farmers, that their agricultural activities are more important than those of women, and that women's agricultural productivity is lower than men's
- socio-cultural practices that restrict women from owning land title, which sometimes is used as collateral for loans and inputs or is needed to participate in development projects
- government policies that favor traditional export crops (mostly produced by men) over staple food crops (grown mostly by women).

Other differences in the problems and needs of men and women farmers include gender variations in tasks performed in crop and livestock production, the allocation and use of household resources, and the distribution of benefits from economic activity. Research, extension, credit, and other service institutions must recognize these differences and be gender sensitive in their programs and strategic approaches in working with farmers.

In many developing countries, agricultural extension services are the primary institution responsible for delivering and disseminating improved and useful agricultural technologies for farmers to adopt. Extension needs the support of research, credit, input suppliers, and policy institutions for adoption to occur.

For the reasons presented earlier in this paper, most of these institutions have failed to reach, extend services to, or assist women farmers. Proposed solutions and challenges to effectively assist women farmers will be relevant to and can be applied by extension service and other institutions.

Reaching Women Farmers Implies Improved Access. Reaching women farmers implies providing them with access to the products and services of agricultural and related institutions. Simply trying to reach women farmers is meaningless and a waste of resources unless they have complete access to all the components of improved technology. With complete access, women farmers will adopt improved technology to raise their productivity, incomes, and food for Africa's growing population.

According to Chaney and Lewis (1980) the concept of total access means the capacity to know, acquire, and make use of. Thus, for any institution to reach women farmers with improved technology the following tasks must have been accomplished:

- Women farmers are aware that the new technology exists.
- Women farmers know where and how to acquire the new technology.

- Women farmers know of the need for and usefulness of the improved technology to their farm activity and productivity.
- Women farmers have the technical know-how to use the improved technology and it is available and affordable.

Considering these elements and their general lack of appropriate and suitable food technologies, women farmers generally lack access to improved technology.

Women Farmers Lack Contact with Institutions. Agricultural development literature shows that women farmers have little or no contact with most agricultural institutions. Further, although women farmers provide labor for the farming sector of most African countries, they were not targeted clientele or beneficiaries of most agricultural projects. Why not?

Despite the important role of women farmers and their contributions to agriculture and national economies, they produce food that, in the past, yielded little or no foreign exchange that governments use for development. This was an excuse for many governments not to invest in or promote women farmers' agricultural activities.

Because agricultural development policy, up to the early 1980s, favored traditional export crops — such as cocoa, coffee, and palm oil — those producers (mostly men) benefitted from the technology and services of agricultural institutions. The results were the following:

- Research and extension services focused on export crops.
- Export crop producers received inputs — such as fertilizer, pesticides, herbicides, improved seeds, and farm tools — at subsidized rates.
- Credit facilities and training were made available to export farmers.
- Export crop producers had a relatively well organized market system.

Since the different models of agricultural development — such as intensive and large-scale farming, integrated rural development, green revolution, and agrarian reform — tended to be export-led, they did not adequately address the technological needs of most women farmers. The policies, strategies, and projects left out women farmers as actors but used their labor to implement and attain their goals.

Not until the deteriorating situation threatened food security in Africa by late 1970s did African governments and international organizations start paying serious attention to the food sector. Experts attributed part the decline in food production to the neglect of women farmers in government policy and by agricultural institutions.

Efforts to correct the causes of food shortage included increased budget allocations, research, food technological packages, and extension services directed to food farmers. In addition, many governments and international agencies included women farmers in their working documents.

The sticky issue for governments and institutions was in designing a suitable and effective strategy of working with women farmers. Three schools of thought emerged:

- The first believed in having separate programs for women.
- The second believed in integrating women into larger or national development programs involving both men and women.
- The third group wanted a development strategy based on equity.

The answer to which approach is correct depends on social, cultural, political, and

economic conditions. For certain, whether the strategy employed is women-specific or integrates women's needs in national programs, structural changes within institutions are needed to enable them to address the special needs of women.

Despite the increased attention to the food sector, strategic changes have not affected the majority of women farmers. They continue to use local technologies like hoes, local seeds, human labor, and indigenous knowledge in farming.

Nor have the various strategies helped institutions to better reach women farmers or improve their access to improved technologies or services of agricultural institutions. Thus, much of the research and extension efforts, credit schemes, market development, and input subsidies focus on crops such as rice, sugar, and vegetable oils production that are in the hands of parastatals and large-scale farmers. Staple food crops that are produced locally, sold in local markets, and consumed locally, such as roots and tubers (yam, cocoyam, and cassava) and plantain received minimal attention.

This lack of emphasis explains the scarcity of appropriate technological packages that can meet or address most women farmers' needs and problems.

Even when improved technology is available, the study by Endeley (1987) reveals that most women farmers lack information about institutions charged with the production and/or dissemination of technologies. Most women farmers are not even aware of where to get technical information or assistance; they do not know about the functions of the extension service or have contact with extension agents. This lack of awareness is worsened by the scarcity of suitable improved technology in local markets and at a price that is affordable.

The lack of awareness of agricultural and related institutions and their products and services leads one to question

- the institutions' interest in assisting women farmers
- the efficiency of their strategies, if they are targeting women farmers
- how women farmers will be able to acquire the know-how to use improved technology

Women Farmers Need Suitable Improved Technology. The lack of suitability of improved technology to women farmers' needs and problems is another bone of contention. In developing countries, the women farmers' domain is the food crop sector. Technologies meant for women should consider

- their multiple roles as mothers, home managers, and farmers
- the high demand on their labor time
- their comparative lack of resources as compared with their male counterparts

Because of their lack of resources, it is unlikely that women farmers will adopt any technology that is labor- or capital-intensive.

Another factor limiting women farmers' access to improved technology is selection of clientele based on gender. For example, selecting farmers based on heads of household, large-scale and progressive farmers, owners of land title, or disposal right to land will exclude most women farmers. This is also true if the strategy employed in working with farmers is individual rather than group oriented or uses mainly male agents in reaching farmers.

Women farmers' limited access to credit institutions adversely affects their ability to adopt improved technologies, even when such technologies are available, suitable, and

appropriate. Although this problem is common to most farmers in developing countries it is worse for women when access to credit is attached to collaterals such as land ownership, export tree crops, or other major assets like houses.

Typically, only informal credit institutions such as saving and loan groups (known as Njangie in Cameroon and esusu in Nigeria) are available to rural women. However, one needs to belong and contribute financially to the group to use its credit facilities. The viability of these local financial institutions is in jeopardy as economic hardship increases.

Another factor limiting women farmers adoption of improved technology is the low prices of staple food crops. Most African governments still control prices of local staple food crops for the benefit of urban consumers. The combination of low prices, an unfavorable land-tenure system, and limited export demand for local staple foods discourages adoption of many improved technologies.

Institutional Challenges in Reaching Women Farmers

Discussion in this section includes institutional development issues in working with women farmers and challenges to the agricultural extension service.

The challenges are of two types: (1) those that demand changes within the institution; and (2) those that address social, cultural, and economic constraints that limit women farmers' access to technology or that limit the institution's capability to reach women with improved technology and institutional services. Institutions should recognize these constraints and alleviate them.

Changes Are Needed Within Institutions. Institutions that desire to assist women farmers need to examine their relationships with those farmers. They need to consider: the regard with which women farmers are held in the institution; the relationship between the institution's philosophy, mission, and goals and its working relationship with women farmers; and whether women farmers are important actors in attaining the institution's objectives and goals.

Women farmers are important extension service clientele in sub-Saharan Africa. Yet they figure less importantly in extension programs than their male counterparts. Most extension services scarcely target or involve women farmers in their activities. Female extension staff are few and hardly any are found at managerial or policy-making levels.

Extension services must address women farmers' problems if they hope to mobilize the majority of small-scale and financially poor farmers to adopt improved technology, increase their productivity, and feed Africa's population.

A training workshop for extensionists, explaining the service's position toward women farmers, will help staff

- understand the extent to which the institution is ready or committed to work with women farmers
- determine weaknesses in the institutional strategy in reaching women
- identify changes needed to improve assistance to women farmers, such as recognizing that they are interested in more than home economics

Institutions Should Target Their Clientele. Institutions need to pay more attention to their criteria for selecting clientele. Few financially poor and small-scale farmers

have access to the agricultural extension service; few agents work with or have programs that meet the needs of poor farmers.

The non-head of household farmers are important extension clientele because they comprise a majority of poor women needing extension's assistance and they tend to manage farms. According to Moris (1991), about 15% to 30% of all farms in rural communities in Africa are operated by women. In areas of high male migration, more than 50% of farms are operated by women.

Studying the different groups of women will reveal differences in their adoption behaviors, as well as their resource distribution and allocation patterns.

Developing Programs for Women Farmers

We have seen that developing appropriate programs and designing an effective strategy to stimulate massive participation of women farmers in agriculture-related activities is a major challenge for the extension service and other institutions in Africa. In these efforts, planners must recognize the following situations:

- Women farmers play multiple roles, sometimes simultaneously, so there is a high demand for women's labor.
- An appropriate technology package might increase the burden and labor time beyond that available to women farmers.
- Women have limited access to production resources such as land and labor, and to collaterals that may be needed to acquire inputs and credit from formal institutions.
- Attending training or demonstration sessions that require them to travel long distances is difficult for women because of the cost of transportation, husbands' restrictions on wives staying away from home, lack of accommodations at the training center, and, especially for mothers with young children, lack of village day-care centers.

Therefore, any institution that aims to reach women farmers must analyze conditions in the area in which it works: the farm environment and socio-cultural practices; ownership of resources and allocation and distribution of benefits; and gender roles of those in the farming systems. In other words, extension programs, for example, must be gender sensitive in terms of who does what, when, how, where, and why; who benefits and who loses; and whose resources are needed to implement the program.

In carrying out this type of study, both men and women should be interviewed. Information about women's activities should be obtained from women themselves through interviews and observation and not from husbands or men.

Helping women farmers adopt more improved technologies requires that the technologies are appropriate and that the farmers have access to the accompanying essential inputs and support services.

Ensuring better access to agricultural inputs and credit is more difficult in countries where subsidies have been removed as part of structural adjustment programs.

Therefore, obtaining funds and in-kind inputs through local institutions — such as women's saving and loan schemes and cooperative groups — should be exploited. These are being used in many African countries. Examples include the Agricultural Credit Bank in Cameroon and lending institutions fashioned after the Grameen Bank scheme in Bangladesh. The Barclay's Bank Lima scheme in Zambia and the SG 2000 project have disbursed credit

to small-scale farmers based on farmers' credit worthiness and potential.

Institutions must guard against projects or technologies that might lead to the marginalization of women farmers' productivity or economic power; otherwise they are likely to be failures and may be unsustainable. This was the case of the Semry Rice Project in Cameroon (Jones, 1986).

Institutions trying to reach many women farmers will be well served if they

- determine incentives that can motivate women farmers to adopt improved technology
- encourage and assist women farmers in organizing child care centers
- bring demonstration and training sessions closer to women's home areas
- consider the time, day, and agricultural season in planning programs and projects for women farmers to avoid conflicts with competing activities

(In Cote d'Ivoire and Zambia, mobile training units have been used.)

Some Agents Work Better With Women. Another important challenge for institutions is determining when it is best to use female agents or either sex of agents to assist women farmers.

Much has been written about the extension strategy of reaching women farmers by using female rather than male agents. The major reason given for using female agents is that communication seems to be better between members of the same sex than with the opposite sex.

Female agents seemed less threatening to women farmers; they understand women's messages, concerns, and confusions better; and they reflect the institution's interest in assisting them (Koons, 1988).

While women farmers tend to prefer female agents, it is wrong to assume (without supporting empirical evidence) that male agents cannot be as effective as female agents in working with women farmers.

The choice of using female agents to work with women farmers is clear only when tradition and religious practices (in Muslim societies, Burkina Faso, parts of Northern Cameroon, and Senegal) prohibit or restrict contact with members of the opposite sex. Otherwise, studies by Walker (1989), Endeley (1992 and 1987), and Spring (1985) to name a few, have shown that both male and female agents trained in agriculture can effectively assist or work with women farmers.

In fact, Endeley's (1992) study on MIDENO found that indicated male agents were more effective than female agents in working with women farmers. The reason was not obvious, but it might be because most males have worked longer and have more experience in extension than most females in the same type jobs.

For cost effectiveness and to prevent further widening of the existing gender cap, institutions should improve the skills and capacities of both male and female staff in working with women farmers.

Since an adequate number of female agents cannot be recruited in the short term, due to the economic difficulties many African countries face, the best choice is to retrain and equip male agents to work with women farmers. However, in the long term, extension and other institutions working with women farmers should increase the number of female agents.

In some countries, this will involve encouraging more girls to take up agriculture as a career and convincing them to become field extension agents. It is not an easy task. However, Weidemann (1987) and Rivera and Gustafson (1991) believe that a mixed male and female staff will improve extension's efficiently.

Suggestions for Reaching Women Farmers. Pre- and in-service training in gender issues should be required for all staff at field and managerial levels. The assumption that all women are gender sensitive and that men are not is not necessarily correct. All staff in agriculture need to be gender sensitive.

While no blueprint exists for reaching women farmers, developing an effective strategy for doing so is not beyond the competence of many institutions. The following ideas should help those institutions that are working with women farmers:

- The low literacy level of women farmers in many African countries requires that extension and other institutions use more simplified communication techniques than the written word and extend simple, but efficient, technology.
- Women's groups (work, saving and loan, cooperative, or social) are assets that can be used by institutions in reaching most women farmers. They also may provide financial and technological assistance to women farmers. Women in sub-Saharan Africa have always used group efforts to alleviate labor bottlenecks, gain favors, and purchase personal and family assets.
- Working with women farmers in groups (especially all-women groups) seems to stimulate their learning potential and encourages them to participate in extension activities. In addition, working with groups is cost-effective.
- Workshops and seminars on group functioning and organization can strengthen women's leadership skills and their ability to express themselves and tell of their needs and problems in a group. Women farmers should be involved actively in conducting demonstrations, field trials, and research activities.
- Women farmers should not be treated as a homogeneous group.
- Husbands and male relatives should be educated on why women farmers sometimes need their special attention and support in carrying out projects or programs. Such education should reduce antagonistic male behavior towards assisting women farmers.
- Institutions need to understand (with supportive data) the socioeconomic and agricultural situation by gender before any intervention in a particular area. All institutions need to understand how the household unit functions.
- An effective monitoring and evaluation system can ensure that women farmers are being reached and have access to improved technology. This is illustrated in the case of Malawi: Spring (1985) reported that agents were made to keep records of their contacts and programs by gender.
- Keep gender-disaggregated data on farmers' behavior in group participation, and on the impact of extension programs and agents on farmers. Saito and Weidemann (1990) offer some simple questions and a strategy for evaluating extension program impact on women farmers.
- Encourage staff (including agents) to do research on women. Such research will help agents think "why women?" as well as to learn more about women's problems and concerns, gender relationships, and communicating with women.

Extension service and other agricultural institutions should set quotas of about 50% for female participation in agricultural development schemes and projects for small-scale and food-crop farmers.

Conclusion

It is obvious that, without a strong sense of commitment by government and institutions (such as extension services) to assist women farmers, few improved technologies will reach women farmers. It is only when there are such commitments that institutions invest the human and capital resources and make the necessary changes in institutional strategy to ensure that improved technology reaches women farmers. The institutional development challenges discussed in this paper can be met by most institutions at minimal cost.

It is clear that, while women farmers need special attention and specific programs to solve their specific problems, most countries in sub-Saharan Africa do not need to have separate institutions to serve the women farmer population.

The exception is a society where religious and cultural practices restrict or prohibit male-female interaction. Even in such cases, a cost-effective strategy is to have a women's unit within the parent institution. This strategy will help to ensure that projects for women farmers are not developed in isolation from national development programs and to ensure that adequate resources are allocated for women's activities.

The strategy of having a women's unit within parent institutions reduces some of the problems that separate women's programs face, such as not having adequate human, financial, and capital resources.

For many other countries, it is cost-effective to have both male and female agents working with and assisting women farmers. However, in the long term, extension and other agricultural institutions that want to get improved technology to women farmers must have a fairly balanced number of male and female staff who are gender sensitive and are knowledgeable in agriculture. The essence is to ensure that women farmers can access the agent of their choice.

Rather than create new extension or other institutions, existing services can effectively address women farmers' agricultural and technological needs. The major requirements are that they

- recognize the constraints of women farmers in adopting improved technology
- provide adequate financial and human resources to alleviate the problems
- assist women farmers in adopting and sustaining improved technology and productivity
- make the changes necessary to enable them to perform the above tasks

The benefits that accrue to women, families, and Africa's agricultural development from women farmers' adoption of improved technology is adequately documented. With access to institutional support, women have improved their access to and use of improved technologies (such as fertilizer, improved food crop seeds, and animal traction), increased their productivity (sometimes even higher than that of their male counterparts), and gained access to alternative production opportunities (Fortmann, 1978; Moock, 1976; and Spring, 1985).

Institutions can be sure that women farmers will adopt appropriate improved technologies for staple food crops (and those that are labor saving) given the right support systems.

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IMPROVED SEED
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Building a Private Seed Industry in Sub-Saharan Africa

Edward T. Shonsey*

Each time I return to Africa, I am reminded of the importance of understanding and respecting the cultures, values, and languages of this great continent. We must take account of them if we are to hold any realistic hope of accelerating changes that will improve life for Africans; we must consider them, for example, to successfully build a private seed industry. My focus, therefore, is quite simple and I approach it from a business perspective.

Over the past 2 years, economic and political systems around the world have changed significantly. The African countries with which Pioneer maintains relationships also are making significant changes in charting new courses toward economic prosperity.

Agriculture is a top priority of most African countries. Several of them are implementing massive agricultural development plans that draw on both internal and external resources.

Even though this common thrust toward agricultural development has many similarities, the laws of each African country are tailored to meet its unique political, economic, and cultural requirements.

Private industry, therefore, must understand the particular environment in which it chooses to invest. Private companies will encounter many issues, barriers, and problems that they will have to address individually and collectively, and that will require both individual and collective solutions.

Seeds Are Critically Important. Seeds are the most important input in all plant-based agricultural systems. They determine the parameters for yield, as well as for the productivity of other inputs. But, in the absence of fertilizer, pesticides, irrigation water, and other inputs, it is difficult for seeds, by themselves, to survive and prosper.

Further, the seed industry represents an aggregate of functions comprising plant breeding, production, supply management, storage, marketing, and distribution. Each of these involves several other different, closely related functions. The seed industry's magic is that it can become involved in and speed the economic progress of developing countries while drawing on the greatest strengths, experience, and resources of both the public and private sectors.

Both sectors must collaborate and balance individual, industry, and economic imperatives to foster successful development. Therefore, the private sector needs to address a wide array of issues and considerations — including agronomic, political, economic, product, market, program, and people — in order to succeed.

* Senior Vice President, Pioneer Hi-Bred International, Inc., Des Moines, Iowa, USA.

Imperatives to be Addressed

Pioneer has learned many lessons in analyzing the barriers to and imperatives for success in African agricultural and business enterprises. Further, we recognize that we have not yet fully experienced or assimilated all the lessons.

However, our successes and mistakes have shown that the following imperatives need to be addressed in order to build a private seed industry in sub-Saharan Africa:

- The market potential must be large enough to attract any business to a country. That, obviously is the first consideration.
- To attract the private seed industry, the country must want to have the business and its people there and it must recognize the need to privatize the seed sector.
- Good managers must be available. Sometimes it is difficult to find suitable managers for seed operations since the best-qualified nationals may leave the country for more-lucrative positions.
- Hard currency needs to be available; the lack of availability of hard currency slows growth.
- Inputs must be available and government control of output flow should be reasonable. On the input side, there often are few or no herbicides, seed bags, production plants, or seed-treatment facilities. Equipment often is lacking, too. On the output side, sales, marketing, and distribution systems often remain controlled by the government. Until that changes, privatization won't happen.
- Governments and international development agencies need to understand the role and contribution of private sector enterprises that, too often, are viewed with suspicion. This suspicion rests primarily on officials' perception of the company's interest in the country; and the question of what the company can get from the country versus what the country can get from the company.
- Financial, human, and physical resources must be available. The public and private sectors in developing countries should focus on strengthening these resources to facilitate building enterprises.
- Plant breeders' rights need to be recognized. The lack of plant breeders' rights keeps firms from trading with or investing in many developing countries. As a practical matter, however, the lack of such rights has not kept Pioneer out of many developing countries. We work around this problem by hiring and keeping the right people and by concentrating on hybrid crops. We often work at a higher level of intensity that makes it more difficult to lose our intellectual property. This situation does, however, limit our opportunities within some developing countries and can make our operations more costly and cumbersome.
- Partners in joint ventures must understand the problems of operating a company. Pioneer firmly believes that it is important to have joint ventures throughout the developing world to enroll governments, citizens, and customers into problem-solving techniques.
- Government rules and policies need to be equitable. Limitations on ownership and capital flow — such as restricting equity ownership by foreign companies and limiting the payment of dividends and royalties — sometimes form barriers to investment. Education is needed to overcome these barriers.
- The profit potential of better seeds needs to be understood. In some places, hybrid seed still is not well-accepted. Farmers, governments, and businesses need to be educated to both the production processes

and profit potential of seeds — and the role that improved hybrid seeds and open-pollinated seeds play. Often, the lack of acceptance of hybrid seeds reflects a lack of an adequate agricultural extension service.

- There must be sufficient infrastructure (such as roads, railways, and storage facilities) to support a seed industry. And public and private financing needs to be available; adequate credit is critical to the success of a private seed sector.
- Limitations on importing and exporting seeds need to be realistic. Decisions about local production versus importing and/or exporting seeds to and from developing countries can pose barriers. Some countries prohibit the importation of seed. Some have committees or agencies to control imports and they set the requirements or fees at unacceptable levels. Often these come in the form of unrealistic scientific, sanitary, and phytosanitary requirements. Some governments give priority to domestic seed, limiting seed imports to the amount needed to cover shortages. As a result, there may not be enough time or incentive to process last-minute requests for seed imports.
- Practical farming/customer problems and barriers must be overcome. They include soil-fertility problems, lack of availability of improved germplasm, and even weeds and insects.
- Seed legislation and rules must be clear and reasonable. Among the main problems an emerging seed industry confronts is the lack of clear seed legislation, or a reasonable set of rules. Business cannot succeed if the government remains the absolute ruler with no recourse regarding its decisions and if the government does not listen to its constituencies. In that case, legislation must be created and implemented so that the roles of government and the seed industry — and the rights of the private and public sectors — are made clear and explicit. Getting such clarifying legislative passed is difficult in many cases because no precedent exists.

Government should support the private seed sector and the private seed sector should, in turn, respect the government's challenges. I find the best, and perhaps the only, solution to these differing interests is an ongoing dialogue between the different sectors.

This continuing dialogue might be accomplished through national seed industry associations or simply regular meetings with appropriate government officials to update them on what is required for the industry to develop.

Such dialogue also will provide opportunities to address other potential barriers, such as price controls and subsidies if either or both of two situations exist:

1. If the price controls restrict trading margins to the point that commercial firms cannot operate.

2. If price controls restrict adequate levels of investment by private industry to cover such critical components as research costs.

Collaboration Between Sectors is Basic. All of the barriers and imperatives boil down to the need for all sectors to collaborate in developing a commercial seed system. Successful collaboration between sectors requires that barriers to trust be broken, attitudes toward risk be realistic, and the fundamental definition of winning be understood.

The last point needs elaboration: winning may have different meanings in different cultures. We speak of success, profits, return on assets, growth, sales, and market share in defining winning. That is not necessarily the definition of winning in Africa. Here in Africa it is simple

— winning means food on the table and job security. Some African partners and citizens have learned words such as cash flow, profit and loss, and asset management, but they have no way of integrating these words into their daily business decisions. We must, therefore, find a way to develop a common understanding of winning in a business sense.

Finally, private businesses in different countries have different — and uniquely nationalistic — methods of filtering their perceptions of the world. That is a mistake. Until we have a cadre of people who have experience in joint ventures and who have worked day-to-day in operations in Africa, we do not know — and will not know — how to do business successfully here.

What Success Looks Like

Describing what success in building a private seed industry in sub-Saharan Africa in the new millennium would look like is a daunting task because success, like beauty, rests in the eye of the beholder. However, I believe that certain parameters, when combined, create a mosaic that accurately describes success beyond the year 2000. The pieces of this mosiac include the following:

- Small farmer groups in public and dependent economies have been transformed to private, self-sustaining agricultural economies.
- A working foundation for long-term improvement in agricultural productivity, import substitution, and food security has been built.
- Technically and environmentally sound technology has been transferred.
- An infrastructure for private enterprise has been created.
- A sound basis for land stewardship has been developed.
- The value of advanced technology is appreciated.
- Small farmer groups have developed the ability to organize and cooperate.
- People's standard of living has improved.

Following are some reasons why this mosiac describes success, along with further implications. Private enterprises will be creative and maintain flexibility; they will be able to adjust quickly to changes in the economic, political, and social environments; they will have a strong commitment to the community and its institutions; they will make responsible decisions; and they will focus on survival in the real world.

Although increasing yields will be a factor for private enterprises, sustaining and stabilizing production will be an even greater ones. This will increase the seed industry's emphasis on breeding for insect, disease, and drought resistance so crops will respond to production inputs under adverse conditions.

Farmers and consumers alike will want this sustaining and stabilizing technology. It will be designed so farmers can take the steps leading from subsistence to more sophisticated, modern techniques. Certainly, the technology has to be affordable. It also must take into account the level at which the farmer is today versus where (s)he will be 10 years from now.

There also will be increased collaboration between extension and research to promote sustainability. This often has been missing in the past.

The Public and Private Sectors Have Roles. Success for the private seed industry at the millennium will include complementary roles for the public and private sectors. The private sector will emphasize producing,

processing, and distributing products. It also will be profitably undertaking research and development.

The public sector will support applied research and development, implement and assure quality standards, promote the seed industry and competition, and work closely with extension organizations to provide information to the farmer. It will successfully oversee regulatory services — including testing and certifying seeds — and enforce marketing regulations.

The government also will influence and provide oversight for a reasonable set of rules to encourage the private sector as well as consumers to do business within the country.

Government regulations, well conceived and fairly enforced, can create a positive working relationship between the public and private sectors that will

- allow risk sharing with reliable partners
- provide local marketing know-how
- facilitate contacts with local banks and public authorities
- facilitate capitalization of low labor and transport costs

Prime outcomes of seed industry success will be increased employment and food security, as well as the acquisition of new technology, technical skills, and management know-how. New companies will increase competition, companies will be able to import and export more easily, and professional organizations will spring up to make communication easier and to promote a balancing of the needs among all sectors.

Improved collaborative working relationships between institutions and sectors will bring new mechanisms for sharing ideas and responding to them, and responses will be more timely and personal. Humanitarian aid will give way to developmental aid. Economic incentives and technical innovations will help people.

The seed industry will not only generate superior germplasm, it will bring the materials and technology to resource-poor farmers. These farmers, in turn, will be not merely customers but key participants in the growth of the industry.

Fitting the Seed System to the Country

In assessing the steps required to establish an effective seed system, we have learned two important lessons.

- One is that the need for seed, especially hybrid seed, is just one item in the continuum of required inputs.
- The other harks back to my opening statement; that it is extremely important to understand the people, their values and their culture, as well as the specific business needs of particular countries and regions in sub-Saharan Africa. This dictates maintaining consistent standards, yet developing different solutions and arrangements for each area.

This means that private industry, in tailoring its organizational framework, shape, and size, needs to take into account

- the demands of the local culture
- the availability of human resources
- local management practices and standards
- the long-term perspective of the market

Our approach to establishing a seed industry in Africa has followed this approach; Pioneer has taken several different paths, each fitting the region and country and conditions therein.

Collaboration Brings Best Expertise Together. In eastern Africa we are establishing a collaborative relationship to bring the best governmental, technical, and business expertise together.

- Nongovernmental organizations (NGOs), whose missions are focused on agricultural development in those countries, bring their skills in working at the local level.
- Pioneer provides its technical expertise and its knowledge of how to introduce hybrid seed, fertilizers, farm implements, and other inputs to increase food production (credit will be available to the farmers so they can buy these inputs).
- Respective governments join in the efforts to achieve the long-term objectives that have been jointly set.

The partners will organize a few farmer groups that will have a stake in the project. One goal is increasing the farmers' self-sufficiency as they adopt the new agricultural technology. A related goal is to change production practices in ways that take account of real world policy and infrastructure conditions. We emphasize smallholders in countries where agricultural output has been hurt by drought, inappropriate policies, and, in some cases, civil war.

The local groups will serve as conduits to introduce high-yielding production packages of seed, essential inputs, information, and improved cultural methods to other farmers in the area. Importantly, the small farmers' voices will be heard in the process; farmers and their leaders will be involved in all stages of the project — from setting up field demonstrations to calculating the net profit at harvest time.

Farmers will attend 1- to 2-day short courses to learn about cultural practices, especially in hybrid production. Because of agricultural stagnation, the governments of several of these countries are strengthening agricultural research and encouraging foreign seed companies to supply expertise and make investments. This strengthens the NGO-Pioneer-government partnership.

We strongly believe that farmers will adopt hybrids in this region. We base this belief on experience in western Kenya in the 1960's. When hybrids were introduced there, both large and small farmers adopted them faster than did the farmers in the state of Iowa (USA) when hybrid maize was introduced there nearly four decades before.

We Are Forming Joint Ventures in Western Africa. Western Africa poses an even greater challenge for us as an organization since only 2% of the maize hectarage is hybrid. That is far less than the 23% in eastern Africa, 53% in northern Africa, and 65% in southern Africa. The challenges for private industry in this part of the world are especially great. Rampant inflation, plummeting monetary values, and the need for extra working capital pose constraints that cannot be overcome simply by restructuring financial estimates.

In this region of Africa, we have formed joint ventures with local organizations and individuals who provide not only agricultural expertise, but also their knowledge of governmental, cultural, and business priorities. We emphasize product distribution and marketing, which require local partners who have the trust of and influence with farmers.

Southern Africa Calls for a Different Approach. Southern Africa poses different challenges for the privatization of the seed industry; thus we have used different approaches in Swaziland, Zimbabwe, and South Africa.

To deal with undeveloped markets and unfavorable economic, investment, and political climates, it initially fell on donors such as the United Nations Food and Agriculture Organization (FAO), the U.S. Agency for International Development, and others to help these developing countries build their national seed programs, which were all state-owned.

Their efforts demonstrated the seed industry's potential to speed development in several countries but, unfortunately, after the donors completed their support, the programs often floundered and, in some cases, collapsed. It became evident that donor agencies or governments alone could not sustain a seed business on a long-term basis.

In Swaziland, FAO, the government, and Pioneer collaborated in developing a seed business. The need was critical. In August 1992, Themba Masuka, Swaziland's agricultural minister, said that about one-third of the country's 700,000 head of cattle were in danger of dying, and Swazi farmers were losing 60% to 100% of their maize crop due to the record-setting drought. During that same year, the government of Swaziland and Pioneer formalized an agreement for a joint venture.

This joint venture is a seed-production company called Swazi-American Seeds Ltd. The newly formed company aims (1) to help Swazi farmers increase their productivity by growing white maize hybrid seed developed especially for sub-Saharan climates and (2) to establish a sustainable and profitable seed-corn business in that country.

The Government of Swaziland and Pioneer work closely with FAO to increase the awareness and use of hybrids, as well as to ease the transition in utilizing the physical facilities that FAO established in Swaziland in 1978. These facilities have been modified so that seed can be dried and conditioned by technology that is different than typically used in Africa; technology that provides more-precise temperature control and handling conditions.

Hybrids are being developed and introduced to fit differing needs. White maize is grown primarily for human consumption in Swaziland, but a small portion of the crop may also be used for animal feed. Maize with a different maturity also is needed to allow farmers to raise a second crop such as pinto beans, cowpeas, or grain sorghum.

Not only has the joint venture helped Swaziland meet its food production needs in the face of record-setting drought, it also is expected to improve the country's overall economy by producing seed for export. Success of the Swazi-American Seeds Ltd. may form a useful guide to other countries.

In Zimbabwe, the seed system operates differently than in other sub-Saharan African countries. Zimbabwe has a relatively well-functioning commercial seed industry. Nevertheless, until now, it has failed to develop or produce sufficient quantities of improved seeds for the wide range of food and industrial crops grown in the country.

These seed-development gaps have contributed to food-security problems, especially among small farmers. Pioneer, with the help and encouragement of the Governments of Zimbabwe and the United States, formed a joint venture with a 14,000-member black farmer-cooperative organization and constructed one of its five major production plants for Africa in a newly established industrial zone in the country. A cadre of agronomic and production experts who have retired from Pioneer went to Zimbabwe to help transfer the new technology and to work closely with seed producers and farmers there.

We believe that the more-competitive system developed through this collaboration between public and private entities will speed the development and spread of hybrid maize varieties as well as of improved farming techniques in Zimbabwe.

In South Africa, we took yet another approach. In the summer of 1992, following in-depth discussions with the Governments of the United States and South Africa and representatives of the African National Congress, Pioneer re-entered South Africa. With the support of all three entities, we purchased a small company; it is wholly owned by Pioneer. The company has established two marketing and distribution systems, as well as a dual research program. One system will work with the large-farming segment; the other will serve the small-scale black subsistence farmers.

Both systems will work directly with farmers, helping them not only with maize, but also alternative crops such as cowpeas, dry beans, and vegetables. We also established a trading organization to work closely with donor agencies in meeting the needs of several sub-Saharan African countries where Pioneer does not have a physical presence. The trading company provides efficient service and timely delivery of specific seeds, including open-pollinated white maize varieties to those countries whose farmers do not use fertilizer or plant-protection chemicals or whose needs are still met with open-pollinated varieties.

Implications of Tailored Approaches

Success in these tailored approaches within each country requires a diverse array of research techniques and considerations:

- We transfer technology and germplasm from breeding programs as far away as Mexico.
- We work closely with local researchers, governmental organizations, and farmers.
- We improve the links between researchers and farmers with on-farm adaptive research techniques.
- We consider the economic climate and limited size of developing-country markets in setting research budgets.
- We assign highly skilled scientists to conduct the needed research.

As a result of this mix and to enhance local capacity, Pioneer has established a fund to finance education and academic programs for individuals who will return to their home countries to apply this knowledge.

Our company's challenge, therefore, in building a seed industry in different countries is to design and implement systems that, in collaboration with other entities, address the needs and opportunities in markets at different levels of maturity. These include sustenance systems, early commercial systems, and even, in some cases, diversified and developed systems. Our flexibility and ability to work with these different systems will determine our overall success.

Intra-company Changes Are Required.

Based on what we have learned, privatization in sub-Saharan Africa will require changes within a company itself, including

- planning product development that realistically responds to market data and timing
- developing pricing, customer-service, and quality-assurance policies that build on the company's culture
- identifying and instituting conflict-management techniques and ways of working with all members of the company team

- creating a flat hierarchical organization structure
- creating a strong policy regarding cultural inclusion and competence
- developing a common corporate language with acceptable methods to communicate negative information
- developing a clear set of expectations for the country controller
- establishing job-focused hiring specifications that are behaviorally anchored
- providing cross-functional team training on available distribution systems, taking account of their economics, reliability, and security
- establishing criteria for the team that chooses appropriate research and development (R&D), production, and marketing/sales systems
- creating a joint team, comprised of operations, production, marketing/sales, and research people, to manage (1) the maintenance of high-quality breeder teams, (2) issues of genetic and product integrity, and (3) a product-release process that is supported by all relevant parties
- establishing a farmer-support group (fostering farmer-to-farmer interaction) that is backstopped by company technicians, including a marketer, an agronomist, and a salesperson
- establishing standards for maintaining the physical plant and product quality by marketing/sales, production, and R&D people who will conduct regular audits to make sure standards are met
- creating inter-country teams to share ideas for increasing company effectiveness and efficiency and for improving leverage with farmer groups
- establishing go/no-go criteria to guide decisions to enter and develop new markets

Conclusion

Based on 15 years of doing business in Africa, I strongly believe that the strategic question for companies is not one of whether they should be in Africa, but rather when, where, and how.

Also, it is not a question of whether the private or public sectors are better at developing and maintaining the seed industry in a country, but rather how the two sectors can best complement each other's expertise. There is no ideal institutional structure for a seed system.

Pioneer, in its local operations as a private enterprise, continues to adapt its philosophy, technology transfer, and learning to provide long-term solutions to emerging problems and to take advantage of emerging opportunities. It will continue to base its strategy on strong alliances. It also will continue to base its business decisions on market and production potential, capital requirements, interest rates, trade barriers, population growth rates, technical aspects such as pests and diseases, credit, agricultural policy, and political stability.

Our imperative will continue to be one of knowing the appropriateness of what is the same, and what is different, in each of these markets and countries. Our strategies, therefore, will integrate profit and products with a commitment to the well-being of the citizens of Africa.

As President Jimmy Carter said in ***Time*** magazine on October 5, 1992, "There is hope for Africa."

Building a Private Fertilizer Sector in Sub-Saharan Africa

H.J.M. Wientjes*

I have been invited to share with you some of our experiences and to discuss ways to stop the decline of fertilizer use. Although my paper focuses on the Ghanaian experience, I will cast these findings in the broader context of sub-Saharan Africa.

We all know that Europe's fertilizer consumption is the highest in the world at 142 kg of nutrients per hectare. This compares with the developing countries' average consumption of 70 kg. Within sub-Saharan Africa, fertilizer use sometimes averages less than 9 kg/hectare (Table 1).

I have some suggestions on an approach and policies needed to evolve a successful private fertilizer sector in sub-Saharan Africa.

Effects of Development Assistance on Africa

As background, we should note that, from the agricultural development standpoint, sub-Saharan Africa has not much to show for the billions of dollars of so-called friendly development assistance it has received since the early 1960s. That assistance has increased sub-Saharan Africa's dependence on the generosity of the old world and caused a disastrous decline in African economic independence.

For a country to increase its food self-sufficiency, its import policies should be realistic, both for food and for agricultural-production-increasing goods. Realistic means (1) providing for the import and distribution of fertilizer and (2) restraining food imports.

I hope the following discussion will show you the pros and cons of privatizing the fertilizer business and, particularly, the way to make fertilizer use take off in Africa. The private sector has the knowledge, motivation, profit orientation, and willingness to operate hand-in-hand with the government if policies are realistic.

Ghana Has Seen Booms and Difficulties. Turning first to Ghana, its agriculture has seen some booms and some serious difficulties — typical of the wider experience of sub-Saharan Africa.

During the 1960s, the Food and Agriculture Organization of the United Nations (FAO) introduced some fertilizer through trials and demonstrations and established standard recommendations for various crops.

From this beginning, Ghana's fertilizer consumption increased to a peak in the years of 1977 to 1980, when a maximum of 75,000 metric tons of product were used. Subsidy levels ranged between 60% to 80% (Table 2). By contrast, Ghana is importing no more than 12,000 metric tons in 1993 and the subsidy level is more or less phased out.

* Managing Director, Wienco Fertilizer Company, Accra, Ghana

Eliminating the subsidy had a devastating effect on profitability of fertilizer use by the farmer; it increased fertilizer prices and decreased its profitability. Hence farmers use less fertilizer, smaller quantities are imported, and the unit cost of fertilizer imports increases further due to smaller quantities imported. Only the prospect of profit motivates the African farmer to use fertilizer.

Taking the standard Ministry of Agriculture calculation, one concludes that using fertilizer on crops like maize and rice is not profitable, based on the low technology farmers use. However, some farmers have no choice but to fertilize due to the extremely low level of nutrients in their soils.

In Ghana, fertilizer is used mainly on two or three crops — maize and rice as well as cotton. The government pays little attention to fertilizer use on the main crops of cassava and cocoa.

A Proposal to Stimulate Fertilizer Use

It is time for drastic action. According to Green Forum, sub-Saharan Africa loses 37 kg of nutrients per hectare each year due to wind, rain, farming, leaching, and erosion. Shifting cultivation exposes land to erosion and loss of nutrients. There is little underused land available. At the same time, the population is increasing rapidly.

For all of these reasons — to feed more people and to stabilize and improve the environment — we must encourage fertilizer use.

Fertilizer use has fallen below optimum levels. The potential fertilizer demand in Ghana is as high as 250,000 to 300,000 metric tons if one takes an average of 50 kg of product per ha of arable land. Once, in 1980, Ghana consumed nearly 100,000 metric tons of fertilizer. However, the demand is close to 10,000 to 16,000 metric tons.

Table 1. Food production and fertilizer consumption.

	Index of food production per capita/1	Fertilizer consumption kg/ha of plant nutrients/2	
Region	**1988-90**	**1970/71**	**1989/90**
Low-and middle-income	115	26	83
Sub-Saharan Africa	94	3	9
East Asia & Pacific	127	36	190
South Asia	116	14	69
Europe	102	88	142
Middle East and North Africa	101	14	65
Latin America and Caribbean	106	20	47
Other Economies /3	113	46	110
High-income economies	100	102	122
World	112	49	97

1/ Average index of food production (1979-81 = 100)
2/ Kilograms of plant nutrients per hectare of arable land.
3/ The classification includes the former Soviet Union, Cuba, the Democratic People's Republic of Korea, for which inadequate and/or unreliable data are available.

Source: World Development Report 1992 (Tables 4 and 26).

This shortfall in fertilizer consumption converts to approximately 900,000 metric tons of food based on the FAO guideline of one bag of fertilizer equals (can increase production by) 10 bags of food. At an average price on the world market for a cheap agricultural commodity like maize, the added fertilizer could have saved the exchequer more than US$ 50 million of food imports.

All great food exporters of the world support their agricultural exports in such a way that the end result can be categorized as a subsidy. Farmers in the major food-exporting nations — with various direct and indirect subsidies — produce crops under more-favorable circumstances than African farmers. Conditions need to change to encourage sub-Saharan farmers to use more fertilizer to economically increase their production.

Based on the Ghana's 1990 food-import bill of approximately US$ 100 million — of which 50% covers products like maize, wheat, sugar, and rice — one should consider whether a 20% levy on these products would be justified to create a situation in which fertilizer prices can be subsidized.

Such a levy would benefit the recipient importer like Ghana because those consumers who wish to purchase imported food should be prepared to pay for it. The subsidized fertilizer prices would benefit the local farmer because they would help lower the cost of producing his/her farm products.

Table 2. Ghana fertilizer imports, prices, and subsidy.

Year	Fertilizer import (MT)	Price per compounds 15-15-15 Cedis	50kg Bag straight S-A/T	Subsidy level %		Maize price (GMP cedis/bag XI		Maize to fertilizer price ratio X2		Rate of exchange ¢ = 1US$	
1979	58,650	10	8	80		80		10.00			
1980	60,460	15	12	65		100		8.33			
1981		30	25	45		165		6.60			
1982	46,500	30	25	45		500		20.00	X5		
1983		58	45	45		1,800		40.00	X5		
1984	48,350	440	295	0		1,000		3.39			
1985	29,999	440	295	60		2,000		6.78			
1986	20,100	780	490	56		2,600		5.31			
1987	38,070	1,380	820	42		4,200		5.12			
1988	43,415	2,300	1,600	30		4,800		3.00			
1989	47,460	3,600	2,350	15		5,000		2.13			
1990	17,840	4,200	3,100	0	X3	8,000		2.58		368	
1991		6,000	3,500	0	X3	9,400		2.68		388	
1992	29,900	8,500	6,000	0		10,000		1.66	X4	443	
1993	12,000	10,000	7,500	0		11,000	(Est.)	1.47		650	7-15-93

Notes:

X1 Government-determine Guarantee Minimum Price (GMP) of maize, in cedis per bag of 100 kg (usually lower than the price the farmer can obtain in the market place).

X2 Ratio of Maize GMP to price of sulfate of ammonia.

X3 Subsidy: Although subsidy states 0%, in reality a subsidy level of 10-15% was still prevailing due to the discount given on government stocks.

X4 Ratio: According to Ghana's experience, if the ratio is above 3, it is just an acceptable profitability, between 2-3 is a danger zone and not profitable for all farmers, below 2 is considered unprofitable.

X5 Drought years.

Those who support this proposal strongly believe that another important ingredient is some form of import restraint or increased levies on food imports. They are needed to allow African farmers to compete with the subsidizing food-exporting nations.

The small-scale farmer is the backbone of Ghana's agriculture and is profit oriented. The small-scale farmer will use fertilizer — as well as improved seeds and agrochemicals — at the most profitable rate if the right environment is created. A reasonable and steady market, created by a balanced food policy, creates profit potential for the farmer; a dependable and ready market for the farmer's produce is more critical.

Some organizations are looking into warehousing fertilizer as a collateral investment scheme. Taking the cyclical nature of Ghana's food prices into account, such an inventory-financing scheme should be seriously considered. This would call for continually educating farmers, but even more important is training wholesalers and retailers who sell agricultural inputs at the rural level.

If Ghana could increase its fertilizer consumption beyond 100,000 metric tons a year, it would reap the following additional benefits:

- The landed unit price of fertilizer materials would decrease by as much as 10% or 15% due to the economies of scale.
- More major fertilizer distributors would enter the business, resulting in healthy competition.
- Special bulk-blending formulas can be created, resulting in a further reduction in the unit cost and, in turn, an increase in fertilizer use.
- Bulk blending and shipside bagging might provide enough experience for exporters to be able to use the same equipment for exporting.

Factors Affecting Fertilizer Imports

Five directly related points will make or break fertilizer usage in sub-Sahara Africa; (1) exchange rates, (2) interest rates, (3) bank charges, (4) taxes, and (5) government licensing. They can have massive effects on the cost of doing business.

An example of moving exchange rates: Ghana's currency in 1982 was ¢2.00 = US$ 1; at the moment it is ¢650.00 = US$ 1.

Ghana's interest rate has been fluctuating between 20% and 35%. Other African countries at the moment have interest charges as high as 60%.

Recent currency devaluations of Kenya, Nigeria, Ghana, and Zimbabwe illustrates the damage that can be done to fertilizer exporters and importers in countries with unconvertible currencies.

Exchange rates. We strongly suggest putting a fertilizer levy fund under the umbrella of either a fiduciary bank or the Ministry of Agriculture. The objective is to create enough local currency so that any importer offered a license can have access to sufficient local currency to purchase equivalent foreign exchange — even if the foreign exchange remains with the central bank to be used later to pay the bill.

Of course, fertilizer can be imported with L/C but most African countries under International Monetary Fund restrictions or guidance do not have the flexibility to finance and hedge

imports. In other words, as in the case of Ghana, 100% of the local currency must be provided at the opening of L/C.

We strongly believe that fertilizer should be earmarked as a strategic material to be eligible for a favorable rate of exchange without resulting in a direct subsidy. In Ghana, where the average devaluation is a minimum of 20% per year over the past 4 years, this will give the farmer a direct saving of 20% of the fertilizer price.

In addition, if fertilizer could be accepted as bankable collateral in a monetary financing scheme, many more possibilities would surface. For example, strategic warehouses all over the country could be stocked with fertilizer under warehouse management by one of the banks in order to secure that the supplier will be paid. Under that arrangement, the currency risk is eliminated.

Interest rates. A continuous, gradual devaluation will automatically result in substantial interest rates. However, we feel that, since fertilizer is a special ingredient for the rural folk, it should be considered as such.

In Ghana, we are paying a 35% commercial interest rate at the moment because the banks see fertilizer as a trading commodity. Agricultural Development Bank (ADB) wishes to be involved in importing fertilizer but can do so only up to approximately US$ 1 million per client due to internal banking regulations.

The ADB present lending rate of 25% for agriculture is extended to fertilizer and this 10% saving is substantial. However, taking into account the massive gain in foreign exchange to the Ghana government if fertilizer use is increased, we strongly suggest that the central bank issue fertilizer bonds and make them available to the major fertilizer importers with a nominal interest rate of 7% per annum. Such bonds will attract fertilizer manufacturers and the relatively low interest rate will also attract general merchants. This will result in transparency as well as keen competition, which, on its own account, will result in cheaper prices for the farmer.

A 10% reduction in fertilizer price will give about a 10% increase of fertilizer consumption over time, which will go a long way toward saving the Government of Ghana much foreign exchange due to the 1-bag-fertilizer equals 10-bags-food ratio.

Bank charges. In most of Africa, banking operations are free and charges are determined by market forces. However, in reality, competition among banks in sub-Saharan Africa for agricultural business is nonexistent.

In most countries in Africa — as well as in Ghana — bankers have to be convinced to be involved in the fertilizer business. Therefore, the banks can charge what they want. Excessive bank charges, in addition to interest, go up to 6.5% and make the total cost of borrowing extremely high.

The various central banks should try to persuade the commercial banks to accept fertilizer as an essential input and allow financing of fertilizer to earn tax breaks in other highly profitable fields such as real estate, general trading, and government treasury bills. In that way banks would be attracted to lend to the fertilizer business.

Tax concerns. Governments can waive taxes on fertilizer to stimulate the banking and private sectors to get involved in selling fertilizer. As a special incentive to fertilizer importers and distributors, a tax break for 5 years would attract them to build distribution points in the interior, which would greatly benefit the local communities in which they were located.

Government licensing. The government must have a say in the quality of imported products but this should not restrict the private sector from jumping quickly to take advantage of new developments.

In Ghana, the SA changeover to urea or, in the future, a NPK changeover to DAP can be made by the private sector if encouraged by the government. We believe that it is up to the private sector to see the prospects of new products and, being stimulated by the government, to accept change.

We are opposed to buffer stocks as advocated by many African governments. Buffer stocks tend to be manipulated after they have been created. The government should put the ball in the fertilizer industry's hands (again, with transparency and competition) and have an agreement with the importers and distributors that, if existing stocks fall to a critical level, it will import because the private sector failed to deliver the goods.

In the case of Ghana, we know that two or three manufacturers would be willing to put their strategic reserve in the harbor except for the fact that the Government of Ghana has fertilizer stocks and keeps on buying. That fertilizer will need to be disposed of within 3 or 4 years after purchase and there's risk that it might have to be sold at distressed prices.

We have seen that the government has several options for reducing the cost of fertilizer to the private sector for the benefit of farmers. Those mechanisms could be used to enable the private sector to cut fertilizer prices without physically transferring money from the government budget to the private sector.

There are additional ways to cut fertilizer costs that do not involve government. One is buying in large quantities. The African Fertilizer Market report, issued by the International Fertilizer Development Center, shows that African purchases are always for only a few thousand metric tons. Relatively small quantities of 500 to 2,500 metric tons are expensive on a per-ton basis and this, of course, increases the unit price to farmers tremendously.

In Ghana, we are saving between US$ 10 and US$ 16 per metric ton for shipments above 10,000 metric tons if we bag the fertilizer in our port. There are limitations to this practice due to the hygroscopic nature of fertilizer; we had a bad experience during the rainy season.

If the infrastructure is available and consumption goes beyond 50,000 metric tons, bulk blending is practical and saves costs. Bulk blending becomes really profitable if 100,000-150,000 metric tons are consumed annually.

Distribution and Marketing Aspects

As mentioned earlier, profit is the vehicle that can move mountains. With fertilizer privatization started and taking off, the distributor's thin profit margin limits competition.

If a subsidy is removed or a currency devalued, fertilizer prices can jump so fast that farmers need 1 or 2 years to adjust and be willing to pay the higher prices. Hence, the squeeze is always on the distributor's margin of profit.

This uncertainty is an unfortunate side of fertilizer privatization and, therefore, a lot of capacity building, education, and credit is needed to smooth the process. Aside from helping assure the distributor the prospect of making a profit, the above-mentioned actions are needed also to enable the distributor and retailer to provide credit to the farmer-customer and, perhaps, to buy back the crop as well.

Excessive competition at the village level is not in the interest of fertilizer privatization; the final wholesaler or retailer must make a reasonable profit to be able to move his product close to the farmer and provide other needed services.

The vast majority of fertilizer buyers in sub-Saharan Africa are small-scale farmers who buy 3 or 4 bags a year to improve their output. The farmer and the retailer should make enough profit to keep them both interested.

WIENCO is trying to establish a private retail network in the middle of Ghana. Progress is slow for there is limited financial capacity in rural areas. Various government agencies need to educate farmers to increase fertilizer use and, thus, distribution.

Although government can help train farmers and retailers in technical matters, we strongly believe that profit is the best incentive. Hence, if the retailer has access to cheap credit, he will use his imagination and commercial motivation because of the profit element attached to his business.

In Africa, only a few major buyers, such as the sugar estates and contract organizations like the tobacco and cotton growers, purchase fertilizer in bulk and settle their bills through a purchase-buybacksystem.

Recommendations to Increase Fertilizer Consumption

The question is not: subsidy, yes or no? Nor is it economic recovery program/sustainable agricultural production, yes or no?

The fact is that concern for the environment and sustainable agriculture are with us in Ghana and in Africa as the possible way to improve our economies — in particular our agricultural production — to reduce environmental degradation, and to increase fertilizer consumption.

Another fact is that the northern countries support their agriculture with all sorts of direct and indirect subsidies.

How do we put these two realities together? Let us take Ghana as a sample case, but Africa in general is the same.

Redirect the Cost of Food Imports. Ghana imported US$ 102 million worth of rice, wheat, sugar, maize, and other agricultural products in 1990. That was 1.6% of GDP and 3.4% of agricultural GDP. Of this, rice and wheat covered 50% of total food imports.

We suggest redirecting the cost of food imports in a way that will lower fertilizer prices to farmers, increase our food production, help the rural economy, and reduce shifting cultivation.

We strongly propose that an import levy of 10% to 25% on wheat and rice be created, with the funds being transferred into a fertilizer revolving fund. Under this proposal, wheat (bread) and rice consumers can continue to enjoy the quality of imported wheat and rice if they choose, but they have to pay for it. The majority of the affluent consumers probably will not feel much of the increased prices.

An Import Levy Can Absorb Some Risks. In the Ghana context, the 25% import levy on agricultural product imports can create a fund in the first year of US$ 25 million, which can absorb the exchange risk or transport charges or even interest charge thereby allowing the fertilizer price to be reduced by approximately 50%. The levy could even be used to subsidize the imported fertilizer by 50%, making a 75% reduction in price.

This will immediately improve the profit ratio for the farmer and fertilizer consumption will increase. Using the FAO rule of 1 bag of fertilizer equals 10 bags of food (maize or rice), in the Ghana situation this translates to an additional local production of 1 million metric tons of food. That assumes that the fertilizer consumption will return to the 1979-80 levels of nearly 100,000 tons.

One million metric tons of food will save Ghana approximately US$ 250 million in foreign exchange and provide a massive injection of capital to the rural folks who, for too long, have been marginalized, not only in Ghana but by most African governments.

However, the following points must be made:

- In case of famine or influx of refugees, emergency measures have to be taken. But it would be prudent and let a farmer enjoy the benefit of the supply shortages and resulting price increases to insure his or her financial strength for future production.
- Unproductive farmers should not be protected; they can continue to produce at uncompetitive and uncommercial levels.
- In case of overproduction, part of the fertilizer revolving fund can be used to create buffer stocks for lean years or shortfalls. This will create cheaper food and allow basic industrialization to start.

In the African context, taking US$ 5.18 thousand million as the food import bill for 1990, a 25% duty or levy would create a pool of funds of US$ 1.30 thousand million. If half of this pool is used for a fertilizer subsidy and figuring that US$ 1 subsidy results in a US$ 1 fertilizer sale, at US$ 200 per metric ton, this increases sales by 3,250,000 metric tons of fertilizer. According to FAO this will produce 32,500,000 metric tons of additional food. This is more than the current shortfall of sub-Saharan Africa.

The beauty of this scheme is that the funds are not requested under aid programs; they are generated internally, based on food imports. If local production is up, food imports will be less, the levy amounts available are reduced, foreign exporters have a better chance, and the cycle repeats itself.

Increased Fertilizer Use Will Cut Costs. Increased fertilizer consumption will reduce the cost per ton of fertilizer (quantity discount), attract competition, increase product turnover, and create equilibrium in fertilizer supply and demand.

If the increase in consumption is strong enough, the government should intervene:

- Government could use the fertilizer revolving fund to stabilize exchange rates in a way that fertilizer importers do not have an exchange rate risk.
- A fiduciary bank could lend money to distributors at a nominal interest rate to pay the importers for fertilizer.
- Government could abolish harbor charges or at least reduce them to the lowest level possible in order to reduce costs further.

Following are other aspects to be considered in recommendations to increase fertilizer consumption.

Transport implications. Increased fertilizer consumption will require increased transport for distribution, which, in turn, will result in increased demand for fuel — a product requiring foreign exchange.

Government has the option to sell fuel for agriculture without a tax or duty. Doing so will have this effect: In case agriculture production is a massive success and the country can export its excess, transporters and exporters will be able to compete better in world markets.

Managing buffer stocks. Governments should not hold buffer stocks of fertilizer; rather it should hand this responsibility over to the private sector as quickly as possible. The private sector should have at least one year's supply of fertilizer in stock. Taking into account that the exchange rate is fixed (private), it will cost the importer only the European or offshore interest rate of 4% to 5% per year at today's values.

Once the private sector has shown that stocks will be sufficient, government can concentrate on other aspects concerning fertilizer. However government should ensure the right quality and a fertilizer law, if not yet in existence, should be promulgated.

Need for education. Government and donors should spend time and effort on educating extension officers, wholesalers and retailers handling fertilizer and seed inputs and, possibly, institute maize and rice produce buybacks. They also should emphasize strengthening the capacities of African agricultural institutions.

Food policy implications. The USA, European Community, and Japan, as the biggest food donors, should stop their useless food aid, which benefits the countries in the north more than the economies of the south.

Let food aid be used only in emergencies. Let it be changed to money aid for balance of payment support so the recipient country can decide whether to buy fertilizer from Europe, seed from the USA, agrochemicals from Japan, or whatever it chooses.

When donor countries stop food aid, African governments should allow food imports, but with such duties and levies that enable the Ghanaian and other African farmers to be competitive with the nations that subsidize their food production and / or exports. This is the most important point in creating a successful private fertilizer trading and distribution network in Africa.

Conclusion

I can say that most sub-Sahara African countries are 30 years young and depend on massive aid that is developed by so-called experts all over the world but particularly sitting in Washington, Brussels, and Paris. It is a shame that these experts have increased African dependence over these 30 years.

If the success of Western economic policies is measured in the same way as its success in development aid and business, more and more African governments will have no faith in this aid or economic recovery-sustainable agriculture business.

Let us measure all policies in the same way. Let us also have the rules the same for all. If the EC is subsidizing its agriculture by 38%, USA by 3%, and Japan by 72%, the IMF should not dictate a nonsubsidy regime on African agriculture. If it does, it should first put the food-exporting countries including the EC, Japan, and USA in line.

I hope that this paper has shown that we are on the way to a total disaster in Africa if we do not change course soon. The United Nations charter states that: "Every man, woman and child has an inalienable right to be free from hunger and malnutrition in order to develop fully and maintain his or her physical and mental faculties and dignity."

Let all of us make an extra effort to make sure we are not part of a disaster but part of reversing the decline and of increasing food production in sub-Saharan Africa. Let us do

this for the satisfaction of the many young and beautiful children of this warm and hospitable continent as well as for our personal satisfaction.

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Transport in Support of Agriculture in Sub-Saharan Africa

Jean H. Doyen*

Before outlining my presentation, I would like to express my gratitude and my appreciation for the opportunity to participate in this important workshop. It comes at a time when the critical importance of agriculture in Sub-Saharan Africa (SSA) needs to be re-affirmed.

While governments generally recognize the central role of agriculture for food security and for export earnings, they rarely have made it the cornerstone of their programs. The discredit cast on direct public interventions, combined with stringent budget constraints, have left many of them uncertain; few have formulated a coherent policy -- like the one outlined yesterday by Benin -- to foster the development of their agriculture.

The positive response of agriculture to adjustment,[1] as well as the lessons emerging from programs to strengthen extension and to revitalize research, provide valuable elements to build a consensus on sector policies. This workshop is an important cotribution to this process. Over the past 5 years, the Bank has undertaken an examination of its support for agriculture in Africa and has further elaborated the strategy outlined in 1989 in the Long-Term Perspective Study (LTPS).[2] The resulting document prepared by Kevin Cleaver, now Director of the Africa Technical Department, is titled "A Strategy to Develop Agriculture in Sub-Saharan Africa) and a Focus for the World Bank[3] The report has been widely discussed in and outside Africa and was presented in draft at a previous SG 2000 workshop. We hope that this strategy, along with other syntheses, will stimulate relfection and help to renew focus on African agriculture.

This strategy paper stresses the role of rural roads and of transport services in linking rural households to the broader economy through the network of towns and cities, on which they depend for marketing their products, for obtaining supplies and inputs, and for social, cultural, and economic services. Transport and communications define the reach of the markets and circumscribe opportunities for rural people.

Recent research by IFPRI[4] in Asia has confirmed the importance of road access as the most significant explanatory factor for difference among villages in fertilizer cost, wages, and crop output. A recent survey of transport requirements of 840 rural households in five areas of SSA[5] has shown that households classified as relatively most successful (highest income) are concentrated in the most-accesible villages. The supply response to macroeconomic reform in Tanzania was stifled by transport deficiencies

* Division Chief, Environmentally Sustainable Development, Technical Department, Africa Region, World Bank.

leading the government and donors to launch a massive effort to rehabilitate roads. Nigeria's relatively well developed road infrastructure has been identified as an important factor in the recent growth of food production.

Road access and transport services are critical for the modernization of agriculture and for the welfare of rural households. My remarks will briefly review the nature of the road and transport challenges in SSA and how they are being addressed. I will cover

- national transport systems
- primary roads
- rural roads
- rural transport and access

I will focus on transport policies and programs that are most relevant for agriculture. Agricultural constituencies need to be more involved in formulating priorities for road infrastructure and transport services. This participation should include shippers and suppliers of agricultural products and inputs as well as farmers associations. It should be institutionalized rather than undertaken on an ad hoc basis.

National Transport Systems

The presentation relies extensively on work carried out under the sub-Saharan Africa Transport Policy Program, especially the components of that program dealing with roads and road transport, i.e., the Road Maintenance Initiative and the Rural Travel and Transport Program.[6,7]

The projections presented by the LTPS for the period 1990 to 2020 imply a steady increase in the demand for transport services at the rate of 6% to 8% per year. This demand will be driven by increasing production and trade, responding to the increased mobility of a rapidly urbanizing population. Over the 1900 to 2020 period, the LTPS projects that

- the population of sub-Saharan Africa will grow from 500 million to about 1.1 billion
- agricultural production will grow at a 4% annual rate, partly due to an expanding urban demand for food, which is expected to increase more than five fold over the 30-year period

This traffic will be moved primarily by road transport, which carries more than 80% of interurban movements. Competition between different modes of transport is limited to specific corridors and is important only for railways, which have problems in maintaining their share of the market.

There are Problems in the Transport Sector. In spite of large investments over the past 20 years, transport services in SSA remain costly and poorly integrated. The sector's capacity is not well used and needs to be restructured. In many African countries the transport sector suffers from

- high unit costs and low quality of services in terms of speed, reliability, and wastage
- deteriorating physical assets, especially roads
- low utilization of assets

Expanding on the above points: a recent joint UN Economic Commission for Africa (ECA)[8]-African Development Bank (AfDB) study points out that the cost of maritime freight for typical imports and exports for West African countries is 30% to 80% above the cost from more-distant ports, particularly East Asia and South Africa.

Regarding the use of transport assets, many African ports have container dwelling times of more than 15 days; public work equipment owned by parastatal organizations frequently is used at a third of the normal rate; and

locomotives and wagons have a low utilization rate.

The transport sector's prime objective during this decade remains to rehabilitate and improve the efficiency of its services through policy changes and institutional and regulatory reforms. In many countries, these changes and reforms are prerequisites to effectively using human and financial resources.

The availability, cost, and reliability of road transport services should concern agricultural producers and policy makers. The trucking industry in SSA is remarkably resourceful and resilient; however it is not very efficient.

A survey covering four West African countries carried out by the French Transport Research Institute (INRETS)[9] showed that trucking costs are well above those in other developing countries — as much as five times higher than they are in Pakistan. The poor condition of roads is a critical factor. The low density of demand, poor market organization, high cost of vehicle parts, and difficulties in obtaining credit are also important.

Corridor studies[9] have shown that administrative controls and regulations by various services add as much as 10% to the cost of road transit through Côte d'Ivoire.

Road accidents, which are a mounting problem throughout SSA, deserve more attention.

SSA trucking operations, which often are small semiformal enterprises, are subjected to numerous regulations. In practice, however, entry and operations are relatively free. Roadside inspections by numerous administrative bodies are a pervasive cause of delays and charges. Regulatory issues of concern to shippers are reviewed only briefly.

Government attempts to organize and allocate cargo through freight bureaus have not served shippers well. The recent reform of Chad's freight bureau — limiting its role to monitoring — was followed by a substantial (more than 20%) reduction in rates.

Use of parastatal truck fleets generally has been inefficient and has stifled the industry's development.

Shippers Need to Participate in Policy Discussions. On the whole, shippers of agricultural products and inputs will be served best by policies that support an enabling and competitive environment for trucking; it is important for them to participate in policy matters affecting their industry.

Regulations dealing with procurement and distribution of motor fuel often negatively impact the availability of transport services, especially in rural areas. Inappropriate pricing policies and subsidies reduce the availability of transport in the countryside.

One third of SSA countries subsidize road motor fuel, often on the grounds of lowering transport costs. Agricultural producers should consider carefully the adverse impact of such policies:

- Subsidies lead to shortages and, eventually, to government allocation of fuel, which tends to favor the needs of the capital cities.
- Taxation of fuel is essential to provide a reliable source of funds for maintaining roads and supporting rural transport programs.

Net: The record in SSA suggests that fuel subsidies do not deal effectively with transport needs and deprives the government of much-needed revenues. Countries that have subsidized fuel also are those with dilapidated road networks and low availability of services.

Agricultural producers should support reliable funding for road maintenance and rural road transport programs and accept adequate and effective taxation of road users to pay for them.

High-cost Transport Undermines Competitiveness. The competitiveness of SSA products is undermined by the high cost and low quality of oversea and regional transit.

Oversea transport is overburdened by documentation requirements, restrictive regulations, and parafiscal fees and charges, as shown by Bank corridor studies and recent product-specific surveys. The comparison of maritime transport costs — supported by consultations with shippers — show that current cargo allocation practices of several West and Central African countries (under the so-called 40-40-20 regulations) hampers shippers' access to the services they consider best adapted to their needs and least expensive.

These practices have kept Africa lagging behind the rapid evolution of worldwide maritime transport and logistics. Two examples of the effect of these practices on competition:

- A recent joint ECA-AfDB[8] study points out that maritime freight for a refrigerated fruit container between Abidjan and northern Europe would cost about $250 more than a similar shipment from Johannesburg to northern Europe ($1000 vs $750).
- The impact of restrictive practices on Côte d'Ivoire's banana industry has been estimated at about $20 million in additional costs[10].

In the present context of tightening competition, agricultural producers and, through them, SSA economies as a whole, have a large stake in opening up markets for oversea and regional transport services. They should actively seek a re-examination of policies governing these services.

Small producers will have to organize and regroup to gain access to the relevant expertise and to successfully pursue recommendations for changes. This will require a better understanding of the operations of the logistic transport chains for specific commodities and of options for improvements.

The closer integration of logistics and marketing will require innovations and more-direct links with oversea and regional consumers. SSA strategy in oversea transport will, by necessity, be one of adaptation.

Road Management and Rehabilitation

There are more than 1 million km of roads in SSA, including about 350,000 km of main roads — about 150,000 km of which are paved.[11]

The bulk of the construction effort took place during the 1960s and 1970s. As networks expanded, institutional and financial burdens overtook the capacity of road administrations to cope with them. The economic crisis of the past 10 years and accompanying deterioration of public finance precipitated the crisis of African roads. More than half of the paved roads and about 80% of the main and local unpaved roads are in poor to fair condition. To restore economically justified roads and prevent further deterioration will require annual expenditure over the next 10 years of nearly US$ 1.5 billion.

The bad news about roads in SSA is that they are in an alarming state of deterioration.

The good news is that countries that have committed themselves to better road policies and have launched massive efforts to rehabilitate their networks and to build up their maintenance capacity.

While SSA is overburdened with the costs of its road infrastructure, it still is largely underequipped. Road density is low, compared with other developing countries; 34m per km compared with more than 500m/km in India. To fully develop SSA's agricultural potential will require more rural roads. Although the situation varies greatly from country to country, the ongoing drive to build up the capacity to manage and finance roads on a sustainable basis is a prerequisite for expansion and upgrading of road networks.

Road rehabilitation and maintenance is well established as a priority throughout SSA. The policy dimensions of the challenges are becoming increasingly clear — particularly the need to deal simultaneously with the nexus of weak institutional performance and unreliable, inadequate funding.

In the context of the good news, it is interesting to look at the approach taken under the Road Maintenance Initiative. Phase I, 1988-90, involved building awareness and identifying needed policy improvements. Phase II, ongoing in eight pilot countries, included helping to formulate and implement policies at the country level.

Phase I orientation for improved road maintenance performance included

- planning and funding all road expenditures on a network basis with arrangements for reliable and timely funding
- gaining operational efficiency by relying on local contractors rather than departmental forces, increasing the use of the labor-based method, and reducing publicly managed equipment fleets
- developing human and institutional resources through (1) increased autonomy and improved staff motivation and utilization and (2) institutional reform that increasess autonomy and accountability

The country reform process showed the need to: develop an institutional framework based on a coherent organizational structure and clear responsibilities; establish separate funding arrangements based on the concept of road tariff; and involve users in management through road boards.

The emerging vision is one of an autonomous agency that is dedicated to roads, under the oversight of users, and operated commercially with directly allocated funds from a fuel tax and other users' fees.

Agricultural policy-makers and producers should cooperate in preparing this reform and in representing their particular interests in managing local roads. They should not shy away from increased user contributions.

Net: Maintaining roads is a well-recognized priority. Comprehensive programs are under way in 15 countries and are being prepared in 8 others. They typically (1) deal with the backlog of deferred maintenance and rehabilitation and (2) support institutional reform and capacity building measures for managing roads.

Tanzania's Integrated Road Development Program, supported by 13 donors at a total cost of US$ 870 million, illustrates the scale of efforts under way. Donors are responding vigorously and are coordinating their efforts remarkably.

The donors' conference held in Brussels in November 1991 firmed up the consensus for the new policy-based approach. The target of the Transport Decade for Road Rehabilitation — US$ 15 billion — is within reach. The dominant constraints — apart from cases of unrest — are lack of progress on institutional reform and lagging mobilization of domestic resources.

Rural Road Strategies

The broad effort under way to put road management on a sound footing should open the way for stepping up expenditures for rural roads. Few African countries have the capacity to mount significant, sustainable feeder road programs. Countries that have built such capacity, like Kenya, are finding adequate support from external agencies.

Four basic considerations need to be taken into account in dealing with rural roads in sub-Saharan Africa, including

- central funding; providing a rural infrastructure will depend largely on resources beyond those that can be mobilized by the communities concerned
- close institutional linkages with main roads
- decentralization and participation of local communities
- focus on maintenance capacity, which has been even more intractable than maintaining main roads

The foremost conclusion of the review of Bank experience with rural roads in SSA[6] is that a coherent framework for rural transport and rural roads programs needs to be established. The framework is needed to: organize collaboration among various agencies and groups at the central, regional and local levels; develop clear planning and funding guidelines; and address capacity-building requirements.

The review suggests that the most effective institutional arrangement is likely to involve a small centralized agency for overall policy development, program planning and management, funding, and monitoring the decentralized authorities that are responsible for local planning and operations. Such units placed within main road agencies — but with adequate autonomy and separate funding — have effectively carried out rural road programs of national scope.

A strong case can be made against establishing feeder-road units within other ministries, e.g. agriculture and interior; such arrangements, often driven by political considerations, have led to a lack of continuity and poor use of resources.

Consider Demand in Rural Road Planning. The key point in planning is to think in terms of a system with defined procedures through which key constituencies can be involved. Priorities should reflect the factors that determine community demand for rural roads, e.g. population, area, production, social and cultural services, and so on. Increases in personal travel also are an important benefit of improved rural access.

Funding and budgeting arrangements should consider maintenance along with improvements and rehabilitation. Typical rural earth roads have an expected life of about 5 years. A consolidated framework also encourages mobilizing local resources through matching fund mechanisms. Such fungibility is essential. In developing rural road design standards, key considerations include

- emphasizing servicability in terms of access for specific vehicles
- seeking reliability rather than width and speed
- adopting labor-based approaches, thereby providing local income
- developing capacities for maintenance and off-road improvements

Mobilizing local resources is essential in developing rural transport policies. Programs that involve local communities in all stages of planning, construction, and maintenance have been more successful than those that do not. In many cases, it will be necessary to build up

local capacity in order to mobilize local resources and to promote country-wide policies. The starting point in most countries will be an action plan covering

- a national strategy for rural transport
- development of labor-based capabilities
- a review of policies affecting transport service in rural areas

The lack of absorptive capacity and limited prospects for mobilizing local resources will, in many countries, restrict the scope of what can be done and make it difficult to reach the target of about US$ 5 billion needed to restore and maintain rural roads in SSA over the current decade.

On-farm Transport Needs to be Considered. On-farm transport activities account for a sizable part of the work in agricultural production and household upkeep. However, programs to raise the productivity of farmers in SSA have, by and large, failed to focus on them. Increasing productivity of on-farm transport and movements

- could be covered under extension programs
- should rely primarily on the initiative of farmers or organized local groups
- need to be encouraged by demonstrations and through advice provided by nongovernmental organizations.

Such on-farm productivity improvements include transport technologies, especially alternatives to headloading (such as wheelbarrows, bicycles, and animal carts), path improvements, and changes in post-harvest practices.

A survey[5] of the transport requirements of rural households confirmed that it is important to broaden rural transport programs beyond roads. The survey points out that there are considerable differences in ownership and use of intermediate means of transport (IMT) among farmers in a given area. Those households considered to be successful (high income) also owned and used the most IMTs.

Since women carry most of the household transport, (70% of the total as measured in time and in ton/km in Tanzania), increasing attention to on-farm transport would be particularly important for them. Women-headed households covered in the Bank surveys had less access to IMTs and included a disproportionate share of the least-successful households.

The economic potential and social value of IMTs and the measures needed to facilitate their dissemination needs to be understood better as IMT usage in SSA has so far lagged other regions.

Several countries have launched programs to deal comprehensively with rural transport at the community level. Tanzania's Village Level Rural Transport and Travel Program will support activities based on its earlier experience[12] centered on Makete, and identified by local communities including

- promoting IMTs and facilitating the obtaining of credit
- involving women in planning community-based access to IMTs
- rehabilitating and maintaining roads and paths
- reviewing policies affecting transport

Ghana also has an interesting program under way, based on a two-track strategy: (1) low-cost rehabilitation of roads and (2) dissemination of two types of low-cost vehicles — cycle trailers and high-capacity wheelbarrows.

The experience from these ongoing efforts will be disseminated and used to prepare guidelines. The collaboration between extension services and transport program officers will be important.

Conclusion

This review has shown the importance of appropriate transport policies for agriculture. It focuses on policy issues and programs that are of highest concern for agricultural producers and rural households and outlines actions under way or suggested.

Priority actions will evolve and differ from country to country. The point that may have the broadest application is the need for more-systematically involving agricultural producers in formulating and overseeing transport policies and programs.

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Water Development Prospects in Sub-Saharan Africa

Guy LeMoigne*

It is a pleasure to speak at a workshop on new initiatives for institutional cooperation in Africa, for the title covers issues of immediate importance both for the rural infrastructure and for institutions that support its development.

I refer mainly to the issue of capacity-building that has permeated the development institutions such as the World Bank and the United Nations Development Program. Hopefully, so far as rural water development is concerned, capacity-building will affect which decisions are made and how they are made.

Most developing countries have concentrated their rural water investment in the irrigation and drainage sector, partly because food self-sufficiency has been one of their major goals. The main rural development issue has centered on the question, "How can we raise more food?" The classic response in the water sector has been another question, "How can we irrigate more land?" Relatively recently, people have begun to ask, "How can we make irrigation more efficient?"

Food Self-sufficiency May Replace Food Security. A number of countries — Botswana, for example — seem to be turning away from the goal of complete food self-sufficiency toward one of food security. Food security implies producing enough in other sectors of the economy to enable the country to import sufficient food. Given Botswana's limited water resources — it has one of the lowest water balances per capita in Africa — this seems wise.

Water is inherently scarce and its supply is highly variable in sub-Saharan Africa. The costs of producing new water supplies are mounting rapidly. There also is intense competition for water, both within agriculture — between farming and livestock, for example — and between agriculture and other sectors of the economy, such as power supply and industry. One possible solution to the supply problem — a drop in the rate that demand grows — is unlikely.

Because of water's inherent scarcity and the increasing cost and competition for it, the focus of using it in rural areas is turning from new irrigation to efficient irrigation. This includes improving irrigation technology, pricing water correctly, and managing water efficiently — which usually means privately.

* Senior Advisor, Agriculture and Water, Agriculture and Natural Resources Department, World Bank.

Water Availability in Sub-Saharan Africa

The vast area of sub-Saharan Africa encompasses the following three zones:

- the semiarid Sahelian zone, including the Niger, Volta, and Nile rivers
- the humid tropical zone, that includes the origins of the Nile, Zaire, and Zambezi rivers
- the semiarid zone of southern Africa, which is crossed by the Zambezi river.

Water is scarce in the semiarid zones of Sahelian West Africa and southern Africa. The wet tropical zone has relatively abundant water resources.

The major drainage basins — which supply the surface water in sub-Saharan Africa — are the Senegal, Niger, Volta, Nile, Zaire, Zambezi, and Okavango river basins and the Lake Chad basin.

The rainfall distribution varies greatly both geographically and temporally. Annual rainfall in sub-Saharan Africa ranges from several millimeters in the central Sahara to several meters in parts of the humid tropical zone of West Africa. Rainfall also varies greatly from year to year and from one decade to the next, particularly in the tropical semiarid and subhumid parts of Africa.

In West Africa, the wet season occurs between the months of July and September in the northern part of the region. Further south, the wet season includes the months from April to November.

In many countries — including Senegal, Gambia, Burkina Faso, Sudan, and Niger — between 50 and 800 millimeters of rain falls during the short rainy season. In some cases, more than half of the annual rain falls during a 3-month period.

West and southern Africa have suffered frequent recurrent droughts in recent years. The decrease of average rainfall between the 30-year periods of 1930 to 1960 and 1960 to 1990 is shown in Figure 1. During the 1960 to 1990 period, rainfall decreased substantially as compared with the 1930 to 1960 period. This is important because the projections used for many current projects and for a number of water plans were based on the 1930 to 1960 data.

It is difficult to know whether the decrease in annual rainfall in the region is temporary, part of a short- or long-term cycle, or permanent. Part of the problem is that hydrological data is inadequate.

Status of Small- and Large-Scale Irrigation

Like water availability, the status of irrigation in sub-Saharan Africa varies widely. The irrigation development potential — especially how much land is potentially irrigable — in sub-Saharan Africa has been discussed widely. Estimates range from 15 million to 34 million ha.

Authorities also have focused much attention on competition for water within agriculture; for example, whether irrigation or traditional livestock farming provides the most benefits. Some people suggest that a realistic assessment of traditional livestock production on riverine lands could change the cost-benefit analysis of irrigation.

The controversy over the amount of irrigable land in sub-Saharan Africa is taking a back seat to the debate over how irrigation might be developed and managed. Large irrigation schemes developed and maintained by governments — often with large external financial or technical assistance — have been criticized for some time.

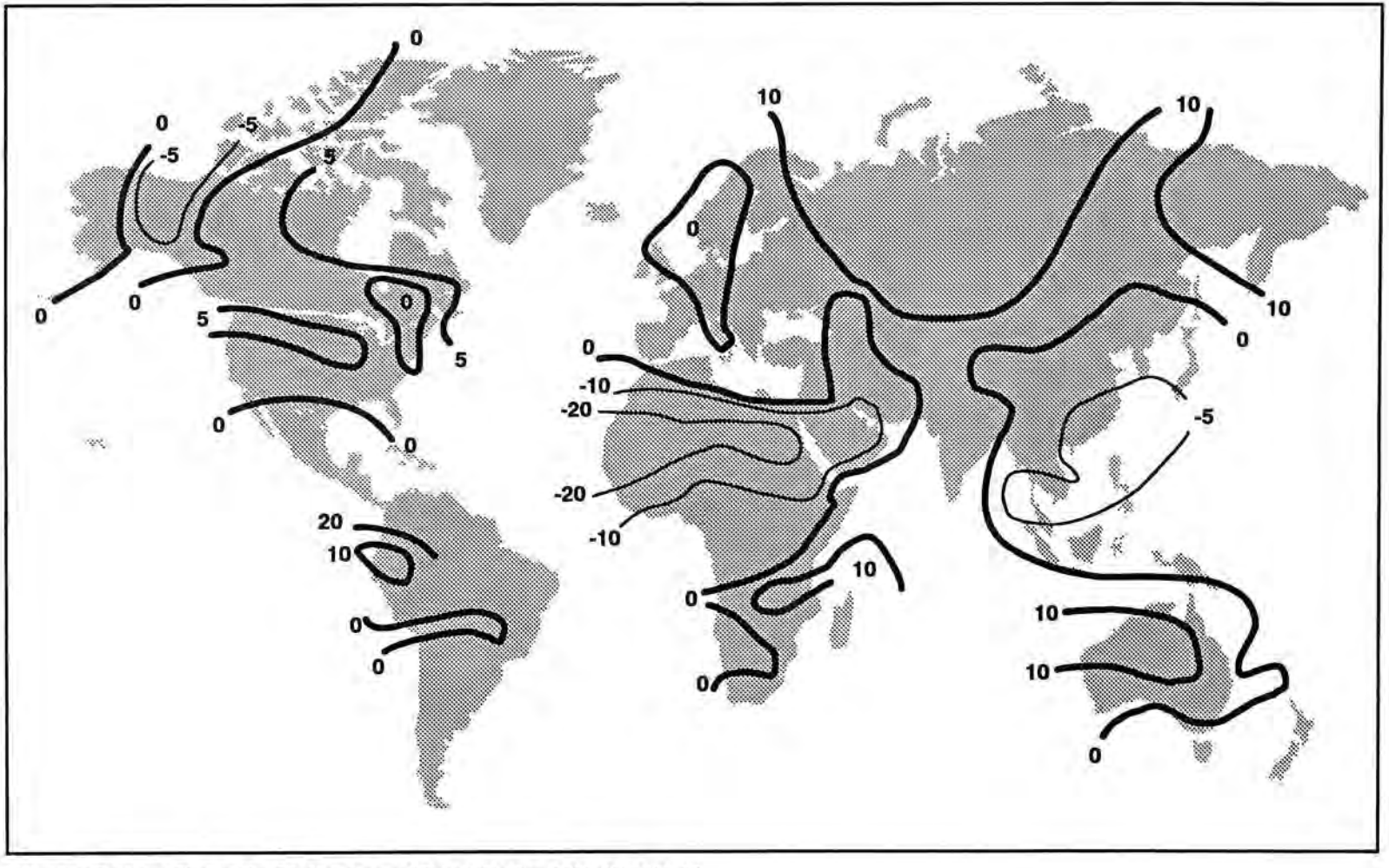


Figure 1. Percent Change in Global Annual Precipitation 1931-60, 1961-90.

Approximately 5.3 million ha of land in Africa are irrigated. Of these, about half are accounted for by private flood, swamp, surface, and low-lift irrigation developed by small farmers. About 500,000 ha, with modern irrigation facilities, have been developed by private-sector commercial farmers. About 60% of the irrigation receives no government funding.

It would be erroneous to say that all large-scale schemes in the region have been failures. A recent study of four large-scale, publicly managed irrigation schemes shows that production of paddy rice increased from about 70,000 tons in 1980-81 to 125,000 tons in 1989-90 in the system managed by the Office du Niger. Production in the Senegal River delta system increased from 17,000 tons in 1980-81 to 60,000 tons in 1989-90.

Further, in many public large-scale perimeters, farmers' demand for parcels exceeds availability, despite the poor overall economic performance. Farmers find that irrigation can raise their production and household incomes.

However, on the whole, the performance of small-scale private irrigation schemes has been more favorable. Farmers and small investors have increasingly engaged in small-scale private irrigation on a self-sustaining, cost-effective basis, with little or no assistance from governments or aid agencies. In fact, within the past 5 years, the main growth in irrigation has occurred in modern, but small-scale, irrigation, with little or no state support.

Net: contrary to stereotypes, not all the large, modern, government-sponsored irrigation schemes have been evil. But it seems clear that privately managed irrigation is the direction in which irrigation development is going.

Policy, Strategy, and Rural Development

The future of rural water development — here I am including all sectors — depends largely on what occurs at national policy levels.

International institutions and governments increasingly are realizing that environmentally sustainable water development depends on having

- adequate policies across all areas of water resources
- strategies to enforce those policies
- the capability to implement the policies and strategies; this capability is especially important in Africa

Reviews of African water sector projects repeatedly recognize the need for community participation in project design, implementation, and management. Projects that citizens consider their own have achieved greater long-term success. At the national level, studies have repeatedly called for developing national water policies and strategies to implement them.

The call for a comprehensive approach to managing water resources that came out of the 1992 United Nations Conference on the Environment and Development in Rio de Janeiro echoed the results of many studies of the water sector. A comprehensive approach

- takes into account as many areas and consequences of water resources management as possible and is based on the country's overall economic development plan
- treats water as an economic and social good

- features decentralized and participatory management of water services, with private and nongovernmental organizations participating.

The World Bank endorsed a comprehensive approach in its 1993 Water Resources Management Policy Statement, which will be available in the next few months.

Treating water as an economic and social good — and calling for decentralized and participatory management — will affect especially rural water developments. As countries state their overall development policies and formulate their strategies, they will seriously consider rural water development in all sectors. They will make difficult choices in meeting their development goals.

In formulating their strategies, many will find that their development goals or policies are simply untenable. For example, a country that aims at food self-sufficiency may find that there simply is not enough water available at an affordable cost to meet this goal. Perhaps the country will alter its goals or it may find new ways to meet the goal in other areas, such as by controlling population growth. I offer these only as examples. Again, it is clear that countries will need to make some difficult choices.

Countries are being encouraged to develop the capacity to make and enforce these choices themselves. The Africa area of the World Bank has made capacity building one of its central issues in encouraging development. African countries increasingly are being encouraged to perform economic sector analysis and to prepare country strategy and framework papers themselves, so that they are the work of Africans.

This area of the World Bank is not willing to tolerate much in the way of policies or projects that are not developed, managed, or sustained with local talent.

Water Policies Involve Countries Working Together. I must add that formulating water policies and strategies in sub-Saharan Africa are not simply domestic matters. River or drainage basins that are the sources of water do not respect country borders.

It is crucial for countries to work together, not simply to avoid conflicts over water resources, but to develop and manage river basins to their mutual benefit. For many countries, international considerations will be primary in their policies and strategies.

The World Bank currently is working with UNDP to develop a guide for countries to formulate their water resources strategies. One of the most important aspects of this guide is the concept of involving the people who have an interest in water policy — what we call stakeholders — in formulating strategies that affect them.

Rural constituents, farmers, and irrigation managers all should be able to, at minimum, express their views about water policy and, working with policy-makers, suggest directions that are consistent with the country's development goals.

All aspects of rural water infrastructure should be examined. One country may, for example, concentrate its development efforts on reducing urban migration and may decide on strategies, and ultimately projects, that will benefit the rural sector.

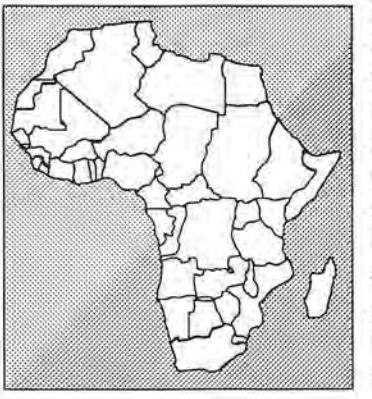
The concept of local people having a sense of ownership of the infrastructure of projects, and on a broad scope, of policies, is an exciting and complicated recent development. It speaks directly to the subject of this workshop, because capacity-building and stakeholder participation are truly two new initiatives for cooperation among international institutions, governments, and domestic groups and individuals.

I am firmly convinced that the tendency is to put rural water management and infrastructure in private hands and its future will be depend on policies and strategies formed by rural sector individuals.

The African Development Bank's Experience in Rural Electrification

Désiré Chokki and Matondo Fundani*

Two-thirds of Africa's rural people live in villages or centers that may consist of a few dozen to a few thousand inhabitants.



They use energy essentially for domestic purposes. It is provided by oil and gas in North Africa and by firewood in Africa south of the Sahel. Indeed, firewood still supplies 70% to 95% of the energy consumed in most African countries. And, although African oil-producing countries supply 10% of the oil on the world market, Africa consumes only about 3% of the oil on that market, according to the past 3 years' figures.

Demand for electricity is weak, for it is used primarily for lighting. Household demand alone often is too low to justify the investments required for rural electrification. Despite its immense potential energy resources — more than 35% of the world's untapped hydroelectric potential is on the African continent — Africa depends to a considerable degree on non-commercial, traditional fuel to meet her energy needs.

On the other hand, rural electrification can improve the standard of living of the people by providing electricity to rural households, agro-industries, health centers, schools, irrigation pumps, and water supply stations in rural areas. In short, it contributes to development, national income, jobs growth, living conditions, and agricultural production.

Stagnant or weak growth in demand for energy, the economic deterioration of most African countries, and other factors help explain the lack of Africa's competitiveness in the industrial and transportation sectors. This lack of competitiveness, in turn, is a brake on economic development.

This is the background for considering the African Development Bank (AfDB) group's activities in energy generation, transmission, and distribution and rural electrification.

AfDB Energy Loan and Grant Activities

From the beginning its lending operations in 1967 until 1992, the AfDB group has committed US$ 25.32 billion for 1,761 loans and grants to 20 African countries.

Of these, its loans and grants in the energy, telecommunications, water supply, and sanitation sectors amounted for US$ 5.6 billion or 22% of the total.

In the energy sector, the AfDB has concentrated on national and multinational projects related to electricity, as well as studies to develop subsectoral development guidelines and to evaluate interconnections. The Bank

* Sectoral Economist and Electrical Engineer, respectively, African Development Bank, Cote d'Ivoire.

also has financed institutional support and technical assistance for several electrical boards on the continent.

AfDB Approved Electricity Subsector Loans and Grants. In the electricity subsector of the energy sector, from 1969 to June 1992, the AfDB approved loans totaling $US 2.52 billion for 118 projects. Of that amount, 55% or about US$ 1.38 billion financed 35 electricity generation projects, including 13 hydroelectric plants at a cost of US$ 282 million.

In electricity transmission and distribution, the Bank financed 62 projects in the same 1969 to June 1992 period for a sum of US$ 867 million, or 34% of the total of the electricity subsector.

The AfDB also financed about 20 studies (such as feasibility studies, guidelines, and detailed pre-project studies) and institutional support, for a total of US$ 112 million. A further US$ 161 million went for an energy sectoral adjustment program.

The AfDB Financed Regional Activities. Turning to regional integration, the AfDB financed the Mono River development study; the Nangbeto hydropower dam; generation and transmission for the Communauté Electrique of Benin (Benin-Togo); the interconnection of Algeria's and Morocco's and of Cote d'Ivoire's and Ghana's electricity grids.

The AfDB's activities also focused on interconnection studies for the West African countries of Nigeria, Benin, Togo, Ghana, Cote d'Ivoire, Burkina Faso, and Mali; a Ghana-Togo-Benin-Nigeria coastal link; Ghana and Burkina Faso; and Egypt and Zaire.

Further, the Bank is considering financing interconnection projects between Mali, Senegal, and Mauritania and between Cote d'Ivoire and Burkina Faso. It is considering interconnection studies for electricity grids in Sudan and Ethiopia; Cote d'Ivoire and Mali; among the member states of the Gambia River Improvement Organization, composed of Senegal, Gambia, Guinea, and Guinea-Bissau. Further, it is looking at the prospect of strengthening the Zaire-Zambia-Zimbabwe interconnection and upgrading the very-high-voltage direct-current line from Cabora Bassa (Mozambique) to South Africa.

Thus, the AfDB has participated in every essential phase of developing the electricity subsector of the continent:

- It is particularly interested in financing hydroelectric projects and projects to interconnect regional grids as part of its strategy to integrate the development of the continent's energy resources.
- It supports projects to upgrade and extend transmission and distribution grids to bring electricity to more African communities.
- It strengthens the capacity of institutions to plan better and manage more efficiently.

Rural Electrification Development

Total consumption of electricity has become a key indicator of a country's level of development. It follows that an adequate supply of electricity is a prerequisite for economic development. In Africa, where most people live in rural areas, increasing the supply of energy for rural development is important for socioeconomic progress.

In order to sustain its development activities, a country needs to maintain its natural resources. Using firewood and other types of biomass for fuel depletes natural resources and harms the environment. Using electricity for energy can improve the standard of living and social well-being of the rural population,

promote and develop the economy, and reduce the exodus of rural people to the cities.

Despite the importance of rural electrification to the socioeconomic development of African countries, the AfDB group's activities in rural electrification are relatively modest. From 1969 to June 1992, AfDB has funded only 12 rural electrification projects in eight countries for a total of US$ 148 million.

This modest level of AfDB financing for rural electrification does not reflect any specific orientation of the Bank's investment policies. It stems from the absence, in most African countries, of a clear-cut and sustained rural electrification strategy.

While most countries drafted development policy guidelines for the electric power subsector during the 1980s, the rural electrification component was neglected more often than not. The number of requests for funding rural electrification projects is, therefore, declining. Eight of eleven rural electrification projects built between 1979 and 1983 were funded by the AfDB, and only three were funded by the Bank between 1986 and 1990.

Tunisia's Investment Policies Are Clearly Defined. AfDB has continuously invested in rural electrification in Tunisia since 1977. The country has built three of the 12 projects and received about 40% of the loans made by the Bank. The country's social and capital investment policies are clearly defined and implemented. Rural electrification has remained a priority of the Tunisian government through a succession of national development plans.

The AfDB helped bring electrical power to almost 1,000 villages between 1977 and 1992. Electricity flowed to 100,000 rural households, 1,500 surface wells, and some 20 bore-holes for irrigation. Electricity became available to 56% of the people in rural areas by 1992, up from only 13% in 1977.

Tunisia has a fourth rural electrification project in its eighth economic and social development plan (1992 to 1996). Lending for the project was approved in March 1993. It will bring electrical power to an additional 50,000 rural households and 730 pumps.

Tunisia's example proves the AfDB group's interest in rural electrification and demonstrates the benefits of cooperation between the Bank and African countries when well-designed and clearly defined rural electrification programs are sustained by unswerving political support.

However, the Bank has not had enough experience in rural electrification to draw definitive conclusions about the problems and possible solutions in financing such projects in a wide range of African conditions. Therefore, the comments in the following sections of this paper are based on personal experience of the authors and remain their responsibility. Their comments should not be interpreted as reflecting the position of the AfDB group.

Electric Power Grids Cover Vast Areas. An electric power grid in most African countries covers vast territory to supply electric power to remote areas. There often are long distances between customers and attractive sites for generating power. Huge investments are required for

- generation equipment sufficient to meet medium- and long-term demand
- transmission and distribution lines to connect new consumer locations
- interconnecting national grids that will reduce operating expenses

- regional linkages to take advantage of varying load, time, seasonal, and hydrologic factors and to promote optimum development of the continent's hydroelectric resources

Main problems in developing power grids are that they are small in scale and not dense, they have relatively weak load factors, and they are necessary to serve villages that cannot be connected to the national grid. The grids and infrastructure must be built from scratch, which calls for high investment in transmission and distribution capacity with low returns.

Electrification is capital-intensive, requiring over-equipping initially to allow for future growth. These high expenditures are keenly felt in African countries.

Financing Often is a Constraint. Typically, electrical boards in Africa try to finance their equipment and service needs with income from operations. But income often is inadequate because of high operating costs, low rates to consumers, and government actions to hold down the cost of electricity to attract industry.

These factors keep electrical boards from making sufficient profits to finance new investments and force them to look for outside financing, often from governments that are deeply in debt.

In light of (1) the precarious financial situation of the electrical boards and (2) the fact that rural electrification is needed to upgrade the national infrastructure and improve the rural population's standard of living, African governments must undertake the designing and financing of rural electrification projects. The electrical boards should provide only the technical concept and serve as the implementing agents and operators.

In the Tunisian example, the government designed the rural electrification programs. The power company, Société Tunisienne d'Electricité et de Gaz (STEG), provided the technical concept and cost estimates.

On the basis of these estimates, the Government of Tunesia provided the bulk of the financing — the entire foreign exchange component and part of the local costs — in the form of subsidies to STEG. STEG covered the balance of the local costs of the engineering component and of monitoring and supervising the work. Subscribers paid for their connections, at a rate based on their incomes, in 20 bimonthly installments.

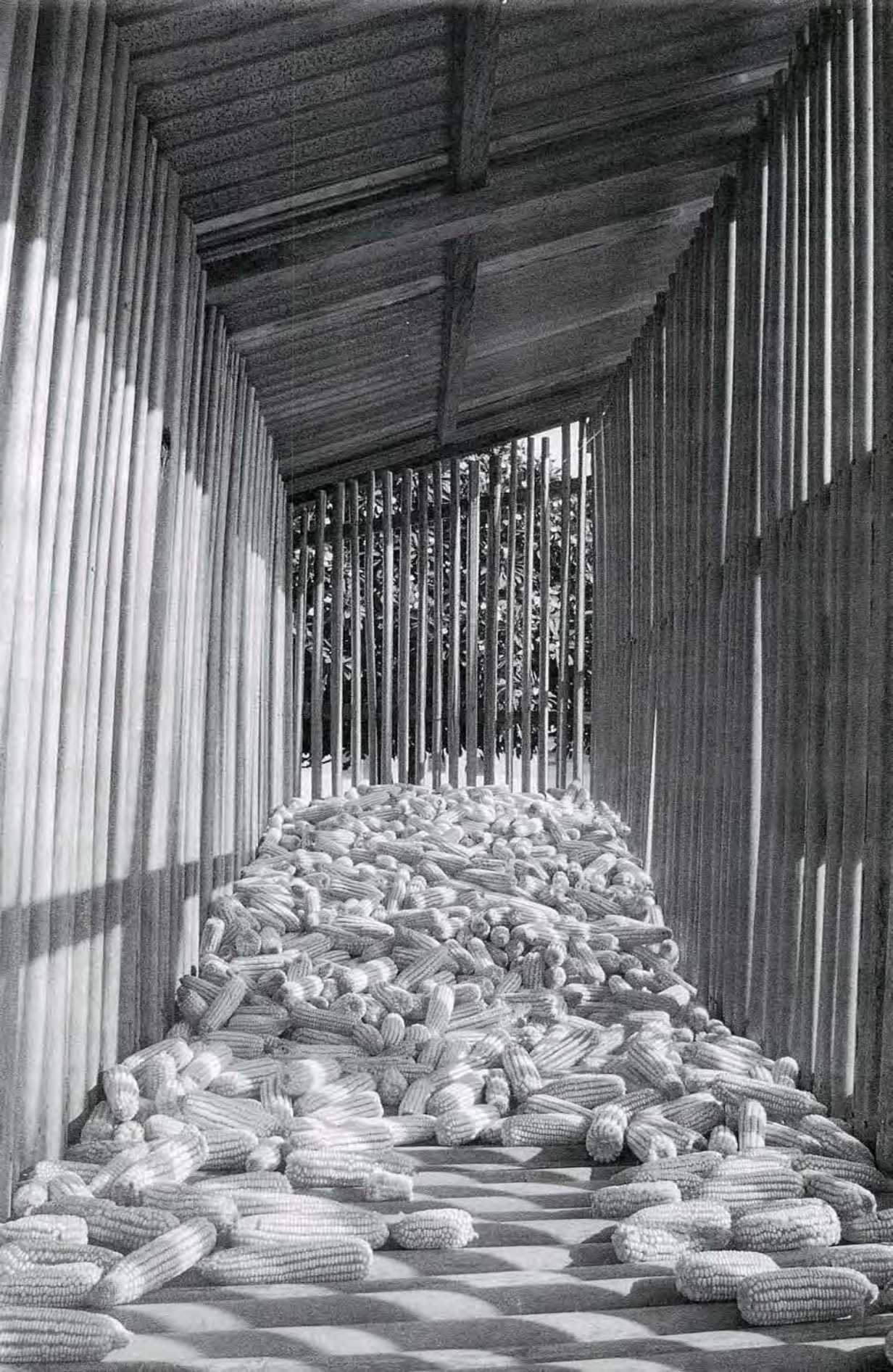
The continuing financial support of the AfDB allowed the the Government of Tunisia to contract and secure payment for loans to finance the hard currency costs. STEG, set free from onerous financing constraints, developed monophase MT distribution grids that produced savings of 20% to 30% as compared to a traditional triphase grid. The collaboration of the Bank, the Government of Tunisia, and STEG made it possible for rural electrification to become a reality in large areas of the country.

Lessons Learned from Bank-Funded Projects

The lessons drawn from the rural electrification projects financed by the AfDB include the following:

- Regarding the technical design of the grids, the monophase medium-voltage distribution technology used in Tunisia since 1977 is cheaper than the traditional triphase system and is the most appropriate for bringing electricity to rural areas with weak loads for mainly domestic uses. The savings from the monophase system were between 20% and 30%.

- In the Tunisian case, the quality of the works and installations carried out since 1979 — and the good results in technical operations — attest to the expertise of the STEG technical personnel in designing, constructing, and operating the grid.
- African electrical boards may draw inspiration from STEG's experience in devising programs and developing rural electrification activities.
- Finally, rural electrification projects financed by the AfDB in Tunisia demonstrate that rural electrification can be a profitable venture and bring benefits from the economic, social, and cultural point of view. Rural electrification remains a field in which government social and rural development strategies can yield high returns.



Private Sector Food and Feed Industry Prospects and Prerequisites

Joseph B. Wanjui*

Africa is often described as a continent in crisis. Problems abound in most facets of its development. Today, for instance, an estimated one out of four Africans depends on food aid and food imports for survival.

Challenging tasks face African agriculture over the next 25 years. Not only must it cope with the demands of rapidly growing populations, it also must achieve enough additional growth to offset current food deficits, reduce food imports, achieve self-sufficiency, and earn foreign exchange.

A viable agriculture plays a strategic role for another reason. Analysis of sub-Saharan Africa and other developing regions has shown that agricultural growth is the most important contributor to overall economic development. According to the World Bank's report on "Sub-Sahara Africa: From Crisis to Sustainable Growth," economic growth of 4% per year for the continent would require the same level of agricultural growth. During the past 25 years, however, Africa managed only a 2% growth rate in agriculture; that in a continent where an increasing number of people are facing famine.

African Agriculture Faces Challenges. What, then, are African agriculture's immediate challenges? Following are three:

- It must find ways of increasing production while halting or reversing the degradation that threatens agriculture in the long term.
- It must halt the trend of more and more Africans going hungry and continuing to rely on food aid.
- It must contribute to economic growth and to the alleviation of poverty and malnutrition by increasing productivity — directly in farming and indirectly through nonfarm activities stimulated by farmers' increasing purchasing power.

Africa has an abundance of land. Some 806 million hectares are cultivatable, of which only around 200 million or one-fourth are cultivated. Yet the present yields of many crops are abysmally low in most countries. Growth in agricultural output is required both through (1) expansion of cultivated areas and (2) increases in yield levels.

According to a 1982 UN Food and Agriculture Organization (FAO) study of the carrying capacity of the continent's land resources, Africa's cultivatable land could produce enough food to feed 1 billion people — even at the low input levels prevailing in most of the countries.

* Development Director, Middle East and Africa Division, Unilever Plc., Nairobi, Kenya

With improved methods, the land could produce enough food for 4 billion people. Zaire alone, for instance, could feed the entire population of Africa using improved, western-level methods and inputs.

What has caused agriculture's abysmal performance in Africa? What are the prospects and prerequisites for transforming Africa's food and feed industry — to reverse the current trend where more and more people are going hungry despite the enormous potential?

One key is to get agricultural development policies right. African farmers respond rapidly to the right policy climate. The conventional wisdom that they are inefficient, tradition-bound, and averse to innovation could not be further from the truth. They are extremely adaptable and manage efficiently, given their difficult environment and limited knowledge and resources.

We can learn from what Kenya has done wrong.

Lessons from the Kenya Experience

Until the end of the 1970s, Kenya's economic performance was hailed as an example of the path other African countries should take. She registered high economic growth rates, fueled by the dynamic private-sector performance in both manufacturing and agriculture. Her pragmatic approach to development led her to perform better than most countries in the continent.

However, in the 1980s, the country began to decline economically. Government increased its interference in marketing and distributing agricultural produce. Some effects:

- Due to lack of incentives, misguided policies, and poor economic management, Kenya's production of such key products as maize and coffee fell.
- The sugar, dairy, meat, and animal feed industries failed to grow despite their enormous potentials.
- Cotton lost its important place in the economy.

Following are closer looks at the effects of government interference in the food and feed industry.

Kenya's Livestock Industry Could Grow. Kenya's livestock sector and its related feed industry illustrates a growth potential that has not been exploited.

The country's livestock sector produces about 7% of gross domestic product. It could generate considerable off-farm employment in marketing and processing related inputs and outputs. It also has a high potential of earning foreign exchange, especially through export of beef products, live animals, pork products, and hides.

Yet, due to excessive top government interference in the marketing, processing, and distribution of livestock products, this sector has failed to take off.

In Kenya, as elsewhere in sub-Saharan Africa, livestock development has largely relied on small-scale farmers. In the dairy industry, there has been a high level of direct government involvement in milk marketing and processing. Price controls and parastatal ownership have led to excessive rigidities and price distortions. These, in turn, have limited or eliminated profits for the farmer and discouraged investment in the dairy industry.

The Feed Industry is Important to Livestock. One of the most important determinants of future growth in the livestock sector is availability of high-quality feeds. In 1986, there were 27 feed mills in Kenya compared to 10 in 1970. Today, the total

installed capacity is 400,000 metric tonnes per year. Unga Feeds Ltd is the biggest miller, accounting for over 66% of feed production. It experienced problems brought on by price controls that have only recently been removed.

The feed industry uses maize, wheat, oats, barley, millet, and other available cereals, which are blended with oil cakes and animal by-products to make animal feeds. In Kenya, maize remains the most important feed grain, accounting for 31% of pig-feed and 36% of poultry-feed costs. Wheat and barley account for 21% of pig feeds.

High-protein vegetable meals such as soybeans, cottonseed, and groundnuts are more important in producing cattle feed than in poultry and pig feeds. Feed manufacturers buy oilseed cakes from factories as a source of vegetable protein. Animal protein is obtained in the form of bone, meat, blood, and fish meals.

Raw materials such as maize are rationed as the first priority is to feed people. The price of maize, the staple food for most Kenyans, is still controlled. All cereals are distributed by a government parastatal. It still is a crime to transport maize from certain districts without a government permit.

Therefore, the feed industry must look for other sources of concentrate feed inputs. Government interference also has affected the growth of alternative sources of oil cakes.

The feed industry's growth also has been hampered by regulations affecting other sectors of the economy. For instance, in the 1970s, East Africa Industries, in conjunction with International Finance Corporation and Commonwealth Development Corporation, invested in oil-crop development with the main objective of making Kenya self-sufficient in oil crops and animal feed by-products.

However, the price controls on edible fats and animal feeds were so tight that it was impossible for the investment to return a profit. The oil-crop development program had to be scaled down, robbing Kenya of an opportunity, not only to save foreign exchange, but also to create a dynamic animal-feed subsector fueled by the oil-crop industry. This, in turn, has affected the poultry, pig, and dairy industries, which rely mainly on imported cake to manufacture animal feeds.

The Cotton Industry Has Collapsed. Kenya was a major cotton producer until the mid-1980s. Cotton played a strategic role in the textile industry, in providing employment, and in the animal feed industry. The collapse of this vital cash crop is best exemplified by a report in the weekend mail of May 20, 1993. It stated:

> Whatever happened to cotton? The cash crop was once so precious that a coastal sultan went out of his way to divert the mighty Tana River 50 kilometers off course to create a delta suitable for its growth. But today, it is a forgotten crop. Only on occasion does it come to public notice.
>
> The present poor performance of the once highly sought after cash crop is reflected in production figures, which show a steady decline. In 1992, production averaged about 30,000 bales (of 185 kg each), a figure only marginally different from the previous season. Yet by 1979, annual production averaged 70,000 bales. By 1986, it had dropped to just below 39,000 bales and it has continued falling.

Kenya Has Failed to Capitalize on Sugar. Another example of the effect of wrong policies in slowing development of agriculture and the overall economy is that of Kenya's sugar industry. In the 1960s and 1970s, the sugar industry grew substantially,

culminating in surplus production in 1979. A record 95,000 tonnes was exported in the boom year of 1980. By 1992, however, production had declined by 25% and imports were again necessary.

According to a United States Department of Agriculture report, Kenya's sugar production in 1993 will be 350,000 tonnes, down from the 372,000 and 434,000 tonnes in 1992 and 1991 respectively.

As a result of declining production, Kenya's sugar imports have continued to grow in the past 10 years — from 30,000 tonnes in 1981 to more than 130,000 tonnes in 1992.

Effects of the loss of a booming sugar industry on the economy are not difficult to fathom. Sugarcane growing in Kenya is dominated by smallholder farmers rather than large estates; these farmers are being denied the opportunity to earn adequate incomes because of wrong policies.

According to a World Bank report on Kenya's sugar sector, pricing has been identified as the major cause of the decline in production. Says a USDA report on sugar, "Growers have witnessed declining return from sugarcane cultivation in recent years and have become disillusioned with the crop."

Kenya Went From Food Exporter to Food Aid. Unfortunately, Africa holds the dubious distinction as the continent that has continually failed to feed itself. In mid-May this year, for the second year running, President Moi appealed to the international community for food aid, citing inadequate rainfall as the main cause of the threat of hunger to 1.3 million Kenyans. Yet in the 1970s, Kenya was a net exporter of food grains. Kenya is not alone as a drought-prone region. Last year, Zimbabwe experienced the worst drought in the country's living memory. Uganda had the similar experience last year. We Africans cannot indefinitely blame weather for the famine afflicting us. It will take time to reverse this trend if existing policies and economic-political mismanagement continue.

A time should come when we can say that, despite adverse weather conditions, we managed to produce enough to eat and even to export. Conventional wisdom tells us that a country's ability to feed its people is an essential element of a country's sovereignty.

Other examples of food and cash crops that have been affected by government interference in marketing and distribution abound. Yet those sectors, such as horticulture, where free market forces are allowed to operate, grow and are major earners of foreign exchange.

Therefore, it is clear that the first prerequisite in transforming the African food and feed industry is to undertake policy changes to make agriculture, agro-industry, and related services profitable. This profitability will stimulate the private sector to invest in agriculture.

Prospects and Prerequisites for Africa

As mentioned earlier, agriculture will need to grow by more than 4% a year to meet Africa's food deficit in the next 25 years. Yet, as we have seen, past trends in the agricultural sector's performance are not encouraging. Indeed, the food and feed industry in the African continent has been characterized by

- low-level use of modern inputs and agricultural methods
- policies that discriminate against farmers

- insufficient investment because of misguided policies and low producer prices
- an unattractive political environment, coupled with gross and unaccountable economic mismanagement
- little emphasis on training of people who could transform Africa agriculture

Growth in the African food and feed industry sectors has been hampered by

- low procurement prices paid by government marketing agencies who have enjoyed a virtual monopoly in many countries
- taxation of export crop earnings — with 50% or more siphoned off to government exchequers or to finance overstaffed and inefficient parastatal marketing monopolies; in Kenya, examples include coffee, tea, maize, and cotton
- such external factors as agricultural subsidies in most western countries, which keep world prices for cereals, meat, dairy products, sugar, and so on artificially low
- poor infrastructure and internal controls and barriers that make access to markets difficult

Correct Actions Can Stimulate Food Output. Given the above scenario, what needs to be done to stimulate the food and feed industry in Africa? The following are some recommended actions:

- Create an enabling environment through policies that send the right signals to farmers and other entrepreneurs. When the terms of trade are shifted in agriculture's favor, entrepreneurs begin to invest their savings. These entrepreneurs may come from diverse backgrounds but they have one common denominator; they will see farming as a sector where money can be made. They will eventually emerge as leaders in introducing advanced technology and commercial methods to the agricultural sector.
- Remove government monopolies, protectionist policies, and price controls to empower farmers and allow market forces to determine prices for agricultural produce. If farmers' incomes remain low, the internal market for manufactured goods stagnates or shrinks, government tax revenues are reduced, and food imports increase.
- Pursue government's proper role in providing infrastructure, building human and institutional resources, strengthening research and extension services, creating production incentives, negotiating terms of trade for agricultural produce with other governments and development agencies, developing efficient input-supply and credit systems, and promoting farming practices that encourage sound use of the natural resource base.
- Create a modern land-tenure system to encourage indigenous production. Uncertainty of tenure in most of sub-Saharan Africa remains a major constraint to agricultural development.

Conclusion

Despite its problems, the outlook for African agriculture is not bleak. Africa's food and feed industry can be transformed if the right policy actions are taken.

An encouraging fact is that most African countries (pushed by the International Monetary Fund and World Bank) are changing their economic management systems to provide incentives to farmers and are opening their economies to market-led policies. African countries need to cushion farmers from the negative short-term effects of structural adjustment programs.

Only a comprehensive approach to the economic problems facing the continent will uplift the standards of the food and feed industry and ensure food security for all. Half measures will not do. Farmers are not going to produce food if they are not allowed to earn money for their labor, investment, and risk. All sectors of the economy must be opened to boost the overall economic growth.

Equally important, only responsive, transparent, and democratic governments will follow policies offering longer-term benefits to the country. Political stability is essential to sustain investments in agriculture, education, health, and other development programs. Before 1988, the majority of African countries had one-party political structures in which party and State were virtually synonymous and political opposition was not allowed.

However, you cannot build democracy on empty stomachs. Nor can agriculture develop in a social political vacuum. The economic and political liberalization which has swept most of Africa may not be sustainable without a strong economic base.

In summary, any growth in Africa's food and feed industry must be based on developing solutions to the myriad of problems; without such solutions, growth will not be sustainable. However, the prospects for growth are enormous, given the continent's changing environment.

With decontrol of agricultural production, processing, and marketing, a greater role for the private sector, improved incentives for farmers, and a stable political environment, there is no reason why African agriculture cannot rise from the depths it currently occupies.

TechnoServe's Experience in Agribusiness Development in Sub-Saharan Africa

Edward P. Bullard
Founder and President
TechnoServe, Inc.

Through a process of trial and error over a 25-year period, TechnoServe has developed a successful approach to creating locally owned agribusinesses in sub-Saharan Africa and other parts of the developing world.

These agribusinesses do not fit the classic definition of agribusiness as used in western developed economies. Rather, they are farmer-owned and -operated enterprises and frequently combine primary agricultural production, value-added processing, and end-product marketing.

These businesses are located in rural areas, close to the supply of raw materials, but not always within easy access to a modern infrastructure of roads, communication facilities, and markets.

Starting Rural Agribusinesses: the Rwanda Success

TechnoServe's experience demonstrates that profitable and sustainable rural agribusinesses can be established and operated by rural small farmers and that helping to create them can be cost-effective. We also have learned that there is no quick and easy path to success. The process requires a long-term commitment by the implementing agency, a professional approach, adequate funding resources, and an economic and political environment that is conducive to enterprise development.

A recent example of the application of these principles to agribusiness development is the CAVECUVI Rice Cooperative in southwestern Rwanda. When TechnoServe began its assistance, CAVECUVI was deep in debt, members were selling their paddy rice to a competing state-run mill, and sales had dropped to dangerously low levels.

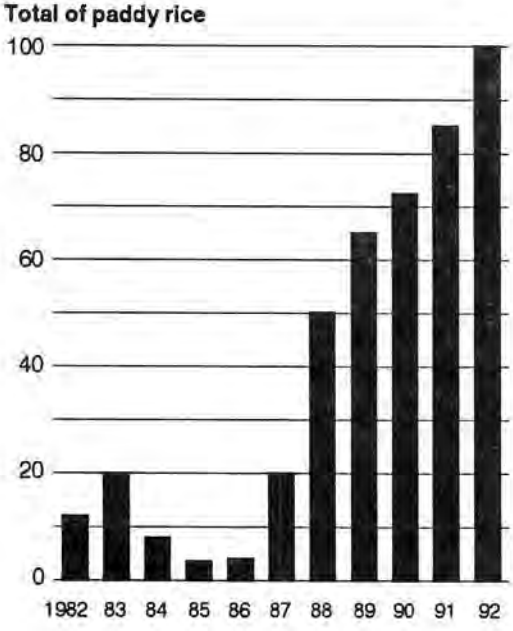
In 1992, after having received extensive assistance from TechnoServe over a 4-year period, the cooperative had paid off much of its debt, non-members were selling their paddy rice to the co-op, and sales were at record levels. With total sales in 1992 of over $500,000, CAVECUVI ranked among the largest private firms in Rwanda (Figure 1.).

Our experience with the CAVECUVI Cooperative, as well as with hundreds of similar rural agribusinesses in sub-Saharan Africa and Latin America, has convinced us that applying these enterprise-development principles can start an economic revolution in the agricultural sector of sub-Saharan Africa.

This revolution will reflect the time-honored traditions of commitment, hard work, free enterprise, and sound business practices. It builds on participatory community development principles and recognizes the need to build the productive capability of indigenous people so that they become better managers of their resources, creators of their own wealth, and practitioners of sustainable development.

Other examples include TechnoServe's work with Sasakawa Global 2000 (SG 2000) in Ghana, Sudan, and Tanzania during the past 5 years. Building on the impressive increases in maize yields demonstrated by SG 2000, TechnoServe is developing agribusinesses built around farmer service cooperatives in Ghana and farmers' associations in Tanzania. Our maize commodity sector work likely will be the prototype for an increasing number of agribusinesses in East and West Africa.

Figure 1. Growth in farmer paddy rice purchases by the CAVECUVI Rice Cooperative.



Lessons Learned From Early Experiences

Shortly after TechnoServe began operating in 1968, we started assisting two agribusinesses in Africa —a rice production enterprise in Ghana and a soybean production enterprise in Zaïre. Neither of these enterprises could be called successful, but both contributed to the learning process of the young TechnoServe organization.

Another early project from which we learned early lessons was an onion production enterprise in Ghana. This business was owned and operated by an individual who, we later realized, lacked adequate capital and the necessary expertise to run a successful business. These and other factors led to the farm's being reduced to one-fourth acre. After TechnoServe devoted considerable time and effort to this enterprise, a heavy rain washed away the quarter-acre crop of onions.

These and other efforts during the early to mid-1970's, led TechnoServe to some valuable conclusions regarding its approach to enterprise development in Africa.

- We realized that if we wanted to reach rural small farmers, we could not rely on individual entrepreneurs. The enterprise needs some type of group structure that allows the cost of assistance and the rewards to be spread over a larger population.
- This led to our belief that we needed to target medium-scale enterprises (particularly with regard to the number of members), as opposed to micro- or small-scale enterprises. Only medium-scale enterprises attract the interest and commitment of rural farmers and offer the prospect of competing in the modern, money economies developing in Africa.

We applied the lessons we learned in the late 1970's and early 1980's. TechnoServe began achieving its aims in Ghana and Zaïre, where we encountered difficulties earlier.

In Ghana, we helped develop two rural sugarcane processing enterprises, which eventually became models for replication by others.

In Zaïre, we worked with several rural farmers' cooperatives that produced basic food commodities and sold them in the Kinshasa wholesale market. During this period these enterprises became successful, and the owners and farmers were well rewarded for their participation.

Looking back on the turnaround in those countries, we saw other critical factors that we needed to correct in our approach.

- Early on, we tended to let our enthusiasm get the better of us and our commitment to the enterprise got ahead of the commitment of the beneficiaries we were trying to help. In effect, the enterprises became TechnoServe projects, rather than businesses to which the real owners should have given 110% commitment.
- In the cases of Ghana and Zaïre, the lack of political and economic stability dealt the final blow. Enterprise development is not relief, and in order for it to have a reasonable chance of success, it needs an economic and political environment that is conducive to the establishment and growth of private economic activity.

The cumulative effect of these and other lessons has allowed us to develop and apply a comprehensive community-based enterprise development approach within the past 8 to 10 years. Because of our success with this approach, we use it to help create successful rural, farmer-owned agribusinesses that are sustainable and cost-effective.

Keys to Successful Agribusiness Development

TechnoServe has found the most important factors essential to the process of developing enterprises to be the following:

- Choose countries with favorable economic environments.
- Target efforts on specific commodity sectors.
- Ensure that beneficiaries have a financial stake in the enterprise.
- Develop enterprises that have adequate scale.
- Focus on transferring capability to the clients.

While this list is not exhaustive, we have found these factors to be important for developing successful enterprises in Africa and elsewhere. Following is a brief discussion of each.

A Business Must Assess the Economic Environment. Enterprise development is difficult in the best of environments, and success is never assured. In the USA, where the basic conditions for creating new businesses are among the most favorable in the world, only one in three small businesses survive beyond 5 years.

In Africa, where government policies and entrenched economic interests are often hostile to new entrants to a given sector, one must assess the economic environment in choosing target countries. Among the factors that contribute to a favorable environment are

- political stability
- agricultural and other policies conducive to developing a business
- a functioning monetary and banking system

- an adequate market for local goods and services
- agro-climatic factors conducive to the crop(s) being considered.

TechnoServe Identifies an Appropriate Commodity Sector. After choosing a target country, we identify the appropriate commodity sector(s) for intervention. We study a sector, analyzing all of the factors at play, from primary production to the end consumer. We determine prices and quantities of products involved, identify distribution channels, and evaluate margins at each link of the chain.

Through this study, we identify the point, or points, in the processing-marketing-distribution chain where a rural enterprise could intervene and provide added revenue to the primary producers.

TechnoServe's most successful agricultural enterprises in sub-Saharan Africa usually include a value-added processing component, such as cultured milk production in Kenya, to be discussed later. Value-added revenue is cycled through the agribusiness, flows to the primary producers, and then into the rural economy. The extra revenue creates new off-farm employment. Importantly, the processing plant creates a tangible center of activity, the focal point for the smallholder producers who sell their products to it.

Beneficiaries Need to Have a Stake. Farmer-owners must see the enterprise as theirs. For this reason, TechnoServe insists that each member be required to make an equity contribution, either in cash or in kind, to the enterprise.

The member equity contributions are scaled to the size of the enterprise and the ability of the farmers to pay. The amount must be meaningful and significant to the farmers, while being within their means.

Our director in Tanzania approaches the farmers in a direct and unambiguous way. One of his first statements to a new farmer group is: "If all you want is to ask me for money or equipment, I don't have time for you."

TechnoServe has observed that an inappropriate relationship is established when the first transaction between a donor or technical assistance agency and the beneficiary is one in which equipment or cash is given.

Unfortunately, many farmers in Africa believe that development projects will provide them with loans, equipment, or other inputs that most likely they will never be required to pay for. Our project advisors usually are met with incredulous expressions when they state that we will not provide any funds or equipment and, in fact, we will require the group to make a cash contribution.

We have found, however, that this approach provides the basis for a better, more-open relationship in which the group becomes empowered. As a result of this financial commitment, our projects often succeed through adverse conditions when others might fail.

The Business Must be Big Enough. One poor peasant farmer by herself or himself cannot create the critical mass necessary for establishing a medium-scale enterprise or agribusiness. Even fairly well-off entrepreneurs in rural areas of Africa usually lack the capital, know-how, and staying power required to develop a sustainable business.

TechnoServe's approach is based on bringing together a large-enough number of farmers who ideally own, or have access to, their own small farms. In this way they control the

primary production and the enterprise becomes a market for their farm output. Lack of market outlets for the small farmer's production is an important constraint to increased farm output in Africa.

While our target size is what we call a medium-scale enterprise, equity contributions, asset levels, and sales volumes will depend on the commodity, the process, and, to a great extent, the local economy. Asset levels can be low in cases such as service cooperatives, where the co-op acts as an input supply agency and offers storage and marketing facilities for the farmers. In our larger enterprises, the asset levels and sales levels are in the hundreds of thousands of dollars, such as the rice cooperative in Rwanda.

Developing a successful enterprise includes

- establishing a real business, not just an income generating activity for the farmer members
- integrating it into the cash economy of the country
- marketing its products through existing marketing channels.
- competing head-to-head with importers or other local producers; its product should not be artisanal or low-tech

The enterprise will really have a chance at long-term success only if it can meet these measures.

Transferring Capability to Clients is Important. Another element of success in agribusiness development is providing know-how to the farmer group, the enterprise managers, and the employees, so that they develop the business skills to produce, process, and market their product.

The importance of transferring this capability cannot be over-emphasized; it is essential for the future development and prosperity of the enterprise. Our experience in Africa indicates that helping a group of small farmers start a new agribusiness requires 2 years or more of intensive training in all aspects of business management.

TechnoServe also believes in using a minimum number of expatriate staff in overseas programs. In most cases, we use expatriates only to establish country program offices and train long-term local staff. As soon as possible, we turn program management over to host country nationals who maintain close links with TechnoServe and work collaboratively with the home office and field staff from other country programs.

In most African countries there is a cadre of skilled professionals whose talents are under-utilized. TechnoServe, by offering long-term employment opportunities and providing its staff with interesting and challenging work assignments, attracts and holds well-qualified local national employees. By making maximum use of these in-country human resources and employing them fully in the enterprise development process, we achieve many objectives simultaneously.

Applying These Key Principles: The Kenya Example

A good example of the systematic application of these principles has been TechnoServe's work in the dairy sector in Kenya. Our assistance to this sector began in the late 1980s, when our program there identified small-scale milk processing as an enterprise opportunity for rural farmers.

We had studied the sector and determined that there was a technology available to process unmarketable evening milk into a valuable consumer product known as mala milk, a liquid yogurt product. Since Kenyan

consumers were already purchasing mala milk from the parastatal dairy, it appeared feasible to establish a number of small plants, each based on the amount of evening milk available.

Once the sector survey assured us of high chances of success, TechnoServe/Kenya worked with an entrepreneur to establish a trial plant, which would give the idea a real-world test. This plant proved successful, from both technical and marketing standpoints.

Based on these results we moved on to the replication phase, helping small groups of farmers establish similar enterprises. This process involved identifying a farmer group, or groups, that would be willing to make the required commitment and invest the time and money necessary to get such a plant off the ground.

This was a time-consuming process. After several visits to farmers' cooperatives, we identified three groups who would invest their funds to establish such enterprises. All three of them eventually established mala milk plants with extensive assistance from TechnoServe.

While one group has ceased operations, a second group is doing well, and the third group, the Biut Dairy Company, Ltd., has been so successful that it has established a second processing facility.

Our impact on Kenya's dairy sector goes beyond establishing these mala milk plants. The plant at Biut and other private mala plants have become models for others who are establishing similar plants without TechnoServe's assistance.

The farmers involved with Biut and with the other mala plants now are getting more cash income for their evening milk. Kenyan government policies for the dairy sector are changing because of these plants, and other farmer groups in East Africa have visited Biut and are taking the idea back to their home countries.

Conditions for Successful Agribusiness Development

There are no magic formulas or shortcuts in developed successful rural agro-industries. It takes a long time and concentrated effort to develop viable, self-sustaining agricultural enterprises in sub-Saharan Africa. There are three general requisites or considerations:

- The implementing agency must be committed. There needs to be a long-term program for each sector chosen, and the implementing agency should expect to devote 5 to 10 years to implementing the program. The agency must understand the sector intimately and continually reassess it to adapt to changes. Only through a long-term commitment will the agency have a meaningful impact.
- Sufficient funding must be available to do the job right. Developing an enterprise is expensive, and the agency must secure adequate funding commitments over the period necessary. A hard reality of developing agricultural enterprises is that the technical assistance required to get the first businesses established and operating is costly.
- It will take time to see meaningful results. The farmer-owners of new agribusinesses often are poorly educated and unfamiliar with basic business concepts. It takes 2 to 4 years, or more, to transfer the skills that are necessary for the farmer-owners to manage the enterprises. There are no shortcuts to this knowledge transfer process.

We at TechnoServe believe that the commitment of time and expense can be justified by two objective measurements: the cost-effectiveness of the assistance and the sustainability of the enterprises.

We Can Measure Cost-effectiveness. We have developed an analytical tool for comparing costs of our technical assistance with the expected monetary benefits the enterprise generates.

In our methodology we evaluate the monetary gains the farmer-members will receive by participating in the business over the life of our assistance to the enterprise and for a 10-year period into the future.

We then calculate the net present value of these benefits and divide these benefits by the net present value of the cost of our assistance (or estimated costs for projects not completed). The result is our quantifiable cost-effectiveness ratio.

Since the quantifiable indicators will not capture all the benefits that we expect a project to generate, we have developed a complementary indicator. This non-quantifiable benefits indicator is an average of five independent assessments of 13 qualitative indicators of the project's impact.

Three TechnoServe employees, one project participant, and an independent community member perform these assessments. The complementary indicator ratings range from 0.5 to 2.0, with an indicator of 1.0 denoting a project that has no discernable impact. In the case of Biut, for example, the indicator was estimated at 1.45, indicating a strongly positive non-quantifiable impact.

Enterprises Should Continue After We Leave. The second key measure of the appropriateness of our intervention is the extent to which enterprises continue to operate and prosper after external assistance is withdrawn.

TechnoServe periodically revisits previous clients to track their status. In this way we can determine which of our clients have achieved financial and managerial sustainability and we can develop an internal indicator of enterprise sustainability. Our goal is for enterprises to achieve 70% sustainability, meaning that we expect 7 out of 10 of the enterprises we assist to continue operating profitably 3 to 5 years after our withdrawal.

TechnoServe believes that donors and implementing agencies alike can justify the expense and the time needed to develop effective enterprises by using the cost-effectiveness and sustainability measures that we apply to our project interventions.

Learning New Lessons: The Ghana Experience

In the mid-1980s, as Ghana was beginning to restore its economic growth, the TechnoServe office was looking to re-establish itself and develop new project activities. At the time, palm oil was identified as an important commodity in the Ghanaian diet and economy, and there were many small farmers in the palm growing regions of the country who had no reliable market for their palm fruit.

Based on these initial findings, TechnoServe/Ghana conducted a survey of the oil palm sector and identified a significant opportunity for economic development — creating intermediate-scale oil palm processing plants. These plants would supplement the production of existing large plants and also provide markets for farmers who were not able to sell their fruit to the large plants.

The next step was finding a farmer group that would make the required commitment and invest the time and money necessary to get such a plant off the ground.

Again, this was a time-consuming process. After we visited dozens of farmer cooperatives, the Ntinanko Cooperative Oil Palm Farmers Society, located near Kumasi, came up with the equity contribution we established as a pre-

condition for our assistance. Once these funds were in a bank account, TechnoServe and Ntinanko signed a service contract and the enterprise development process was under way.

TechnoServe worked with the farmers at Ntinanko to develop the feasibility study and business plan that was necessary to secure additional funding and to establish the operation as a going concern.

Small-scale, manually operated processing equipment was rejected in favor of motorized machinery that had substantially greater processing capacity. This proved to be the right choice, although, in the early days, this decision was questioned.

After a few months of operation it became clear that the enterprise was not making a profit. Labor costs seemed to be the main factor limiting profitability. Because of its knowledge of the sector, TechnoServe was able to work with Ntinanko to restructure the business concept.

Instead of having the plant buy the fruit and sell the oil, the business adopted a service company model, whereby women who traditionally processed the oil themselves used the plant's services for a fixed fee per weight of palm fruit processed.

With this simpler and less expensive structure, the business turned around and became one of the more successful rural enterprises TechnoServe has assisted in Africa.

Shortly thereafter, Ntinanko became the model for creating four other palm oil processing plants established with TechnoServe assistance. These efforts attracted the attention of the Ghana Government, as well as of a multilateral donor that had a tree crops promotion project.

As a result of our work in the oil palm sector, the donor's tree crops project was redesigned to incorporate TechnoServe's village-based processing model, which called for us to establish an additional 60 small plants over 5 years. Now 2 years into the project, TechnoServe has initiated work at 30 project sites.

Palm Oil Success Demonstrates Key Lessons. The process we followed with palm oil in Ghana demonstrates how consistently applying the key lessons we have learned can lead to success. Based on our experience with palm oil, we believe that other factors contributed to the successful development of enterprises in this sector. These factors are:

- The enterprise concept includes an industrial processing activity, which adds value to the primary production, increases margins, and provides a clear focus for the farmer-owners.
- The production and processing activity is virtually a year-round activity, contributing to a sense of continuity and helping in the learning process.
- The enterprise builds upon naturally occurring village groups, many of which have had previous experience with traditional forms of palm oil processing.

Our efforts to develop rural, medium-scale palm oil enterprises in Ghana have been particularly cost-effective. Our assistance to the first enterprise, Ntinanko, which absorbed our sector research costs, had a cost-effectiveness ratio of 0.71, reflecting the experimental nature of the effort. Our second project, the Prestea Cooperative, had a cost-effectiveness ratio of 5.10, and we expect the individual project ratios to continue to climb as more and more enterprises become operational.

Conclusion

As indicated previously, during the past 8 to 10 years we have refined our community-based enterprise development approach. It is yielding successful enterprises and defines our current methodology in sub-Saharan Africa.

During this period, TechnoServe has assisted dozens of rural community based enterprises in Africa, and these enterprises have provided financial and social benefits to thousands of rural small farmers.

Based on these results, TechnoServe is now convinced that rural agribusiness development in sub-Saharan Africa is possible, practical, cost-effective, and critical to developing the agricultural economies of most African countries. A wider application of TechnoServe's enterprise development methodology could create revolutionary progress in an area of the world where there are few successes.

There are no quick fixes for the problems besetting African agriculture. Only an integrated approach, which invests significant amounts of time, money, and attention to the human, technical, and managerial aspects of enterprise development, has a chance of success.

Despite the success of our efforts, they are relatively insignificant in the face of Africa's needs, so there is no lack of opportunity for further expanding the use of our approach to enterprise development.

TechnoServe's contribution to building a solid agricultural economy not only will enable African nations to better feed themselves but also generate wealth, particularly in rural areas, which will support social services such as education, health care, housing, and so on.

We are proud to collaborate with Sasakawa Global 2000's efforts to build a vibrant agricultural economy which is a necessary foundation for the future development of Africa.

Integrating Zimbabwe's Small-Scale Farmers Into Commercial Marketing Systems

M. Rukuni
Professor of Agricultural Economics
University of Zimbabwe

Today, Africa is the world's poorest continent. In the space of 30 years — from 1960 to 1990 — it went from a position of food self-sufficiency to a hungry, malnourished, impoverished, and disillusioned continent.

Commentators agree that uplifting the economic structure and destiny of Africa places a heavy burden on the food and agriculture sector. Because most Africans depend on agriculture for employment and income, it follows that it is necessary to raise agriculture's productivity in order to raise the average African's standard of living.

State of Zimbabwe's Agriculture

Zimbabwe, a medium-income nation with a per capita gross national product of US$ 650 in 1989, often has been cited as an agricultural success story. It has demonstrated that both large-scale white (commercial) farmers and black smallholder (communal) farmers can be dynamic forces in agricultural and national development.

The Country Has Achieved Agricultural Successes. The highlights of Zimbabwe's agricultural success story are the following:

- In 1949, Zimbabwe became the second country in the world, after the USA, to develop hybrid maize following 17 years of research by a small team of local researchers. Research achievements by local scientists — reinforced by investments in seed multiplication, roads, fertilizer distribution facilities, extension, and guaranteed government prices — triggered a boom in maize production by commercial farmers starting in the 1950s. This agricultural production revolution by commercial farmers helped Zimbabwe earn its reputation as an agricultural success story.
- After 40 years of research — from 1925 to 1965 — on cotton insects and diseases, cotton production accelerated in the 1960s and 1970s. Today 100,000 communal farmers produce cotton. All cotton is handpicked to generate employment and ensure quality — a prime consideration in Zimbabwe's aggressive search for niches in international markets.
- In the 1980s, Zimbabwe's communal farmers dramatically increased maize and cotton production. The mini production boom by communal farmers in the first half of the 1980s proved that small family farms

of 2 to 3 hectares (5 to 7.5 acres) can be productive and profitable. What is required is that racial barriers be removed and that the smallholders have access to modern research, extension, and marketing services.

- Zimbabwe is one of the world's leading tobacco exporters.
- After the government encouraged farmers to diversify beyond maize production in 1986, Zimbabwe's commercial farmers invested in horticulture, producing and marketing game, ostrich ranching, and crocodile farming.

Smoldering Problems Remain. Beneath the surface of these agricultural successes are smoldering problems that pose difficult political and economic challenges:

- Real (inflation-adjusted) per capita incomes were lower in 1989 than in 1982.
- Malnutrition is the biggest killer of children between 2 and 5 years of age.
- Thirty percent of Zimbabwe's school children are chronically malnourished and stunted in growth, according to the 1989 report of the country's Central Statistics Office.
- The average daily calorie supply in 1988 (2,132) is the same as it was in 1965 (2,105 calories). This level is about 90% of the average requirements.
- Unemployment increased at an alarming rate in the 1980s.
- Rural poverty is widespread and land distribution remains unequal.

Zimbabwe's Agricultural Development Experience

Cecil Rhodes colonized Zimbabwe in 1890 but, after failing to find gold deposits on a par with those in South Africa, the European settlers turned to farming in the mid-1890s. The settlers established farmer associations, developed a political power base, and promoted research, pricing, marketing, and credit policies that directly and indirectly discriminated against black smallholders.

The white settlers then got Parliament to pass various land ordinances that increased their control over prime agricultural land. This explains why, at independence in 1980, Zimbabwe inherited a dual agrarian structure of roughly 5,000 white-owned commercial farms and 700,000 small-scale communal and small-scale commercial farms.

The First Agricultural Revolution Featured Commercial Farmers. In about 1920, the Government of Zimbabwe made a major policy decision to invest in the five prime movers of agricultural development, which are

- new technology, produced by public and private investments in agricultural research
- human resource and managerial skills, improved by schools, training centers, and on-the-job training
- biological capital (such as improving livestock herds and planting, spraying, pruning, and maintaining tea and coffee trees) and physical infrastructure (such as small dams, irrigation, roads, and grain storage facilities)
- farmer support institutions (such as marketing facilities, credit institutions, and fertilizer and seed distribution systems)
- economic policies that encourage investment and increasing production

Developing these prime movers over the 1920 to 1950 period laid the foundation for the first agricultural revolution by commercial farmers, who increased maize, cotton, and tobacco production from 1950 to the present.

For example, research on hybrid maize was initiated at the Harare research station in 1932 and, as mentioned earlier, after 17 years of study, Zimbabwe became the second country in the world to introduce hybrid maize seed to farmers. The availability of the new hybrid maize varieties, nitrogen fertilizer, and other factors increased average maize yields and contributed to Zimbabwe's first agricultural revolution starting around 1950.

Likewise, cotton research over the 1920 to 1950 period laid the foundation for a large increase in cotton production by commercial farmers, also beginning in the 1950s.

But the direct benefits of the first agricultural revolution were garnered by a few thousand commercial farmers who controlled half the arable land in the country at independence.

Zimbabwe's experience in developing the prime movers of agricultural development took roughly the same three to four decades that it took the USA (1880 to 1920) and Japan (1890 to 1930) to develop their prime movers.

The Second Agricultural Revolution Featured Smallholders. At independence, the basic agricultural institutions of research, extension, credit, and marketing were primarily serving commercial farmers. The new majority-ruled government directed the leaders of these institutions to reverse their priorities and direct their primary attention to meeting the needs of smallholders and give secondary attention to the needs of commercial farmers.

Zimbabwe's second agricultural revolution was spearheaded by smallholders growing maize and cotton, primarily in the higher rainfall areas and in the years from 1980 to 1985. No single factor — seed, fertilizer, or credit — accounted for the dramatic increase in smallholder production of maize and cotton; rather it is partially attributed to the new government's political decision in 1980 to level the playing field and help smallholders expand production.

This political support, combined with peace in the countryside, enabled smallholders to bring abandoned land back into cultivation and gain access to government credit and to new marketing depots in rural areas.

Without question, smallholders benefitted from spillovers from farmer support institutions that were pioneered and nurtured by commercial farmers over many decades.

The Public-private Mix May Vary. Most of the investments in Zimbabwe's prime movers were public, but the mix of public and private investments can vary, depending on a nation's ideology, history, and institutions.

A forthcoming publication by Mashingaize reports that Zimbabwe's maize research was primarily financed by the government until commercial farmers launched the Rattray-Arnold Research Station in 1973. Today, maize research is financed by public and private investments by national and international entities.

A similar forthcoming study by Mariga points out that, from 1979 to 1989, smallholders increased their share of national seed-cotton production from 20% to 62%.

Two other forthcoming studies — one by Tawonezvi and one by Tattersfield and Havazvidi — report that Zimbabwe's seed supply system is the crown jewel of seed systems in Africa.

This seed success story dates back to 1940 when a small group of commercial farmers established the Zimbabwe Seed Maize Association to produce certified maize seed

under the supervision of the Ministry of Agriculture. Later, the association, cooperating with the government, released the first double-cross maize hybrid seed in 1949. Today, 164 private farmers produce hybrid maize seed, which is marketed at home and in a dozen countries throughout Africa by the Seed Co-op Company of Zimbabwe.

Investments in Prime Movers Are Important. Zimbabwe's two agricultural revolutions highlight the importance of long-term investments in the prime movers of agricultural development. Compared with other African nations, the Government of Zimbabwe has exercised unusual political leadership in investing tax revenues from exports into the prime movers; investments that are inherently risky and have an uncertain payoff.

The country has demonstrated that the agricultural sector can contribute to national development by increasing agricultural production, driving down the real cost of food in the average diet, generating jobs and foreign exchange, and serving as a growing market for products of the industrial sector.

Reforms for Smallholder Development

Following are the key policy and institutional reforms that Zimbabwe pursued after independence to support smallholder agriculture.

Pursuing land reform and resettlement. Land is arguably the most important factor leading to the Zimbabwean liberation war.

In 1981, after independence, the Tribal Trust Lands were renamed communal areas. Also in 1981, a Ministry of Lands, Resettlement and Rural Development was established. Its goal was settling 162,000 families over the 3-year period, 1982 to 1985.

Two resettlement models were pursued. In Model A, farmers were settled in a fashion similar to that of the communal areas but under a permit. Under Model B, collective farms were established; they generally failed because of poor infrastructure, financing, and management.

A number of obstacles plagued the resettlement program. Land was costly and, since it was purchased under the "willing-seller/willing-buyer" stipulation of the Lancaster House Constitution, land was available mainly in marginal production areas and on an ad hoc basis. (Zimbabwe's independence and constitution were negotiated at Lancaster House in London. Under the agreement, the terms of the Lancaster constitution were in effect from 1980 to 1990.)

Although, in 1985, a Land Acquisition Act was passed, giving the government the first option to purchase land that was put on the market, there remained a lack of large blocks of land where planned resettlement would be more feasible. The limited infrastructure and limited access to water also hindered progress of resettled farmers. By 1990, only 52,000 families had been resettled on 3.3 million ha and the ministry responsible for the lack of progress had been abolished.

On 18 April 1990, Zimbabwe was 10 years old, and its new single-chamber parliament got new powers to rewrite the Lancaster House Constitution. Land reform became, once again, a topical issue and the government changed the laws and passed a new land policy. The government's land reform proposes to resettle 100,000 families on 5 million hectares acquired in the high potential commercial zones.

A major lesson from the resettlement program is that planning, servicing, and staffing resettlement areas is resource intensive. Also,

the program resettled many displaced and landless people who, often poor and without their own draft cattle, struggle to make a living and secure their food needs.

Because of these problems, the Zimbabwe Farmers Union, representing communal farmers, has taken the position that the poorest people should not be resettled; they recommend that farmers with adequate resources and a proven track record in farming be selected for resettlement.

Providing marketing outlets. Perhaps the restructuring program's greatest impact was in providing marketing outlets for grain and cotton in communal areas.

In 1980, there were only three Grain Marketing Board (GMB) depots in communal areas. By 1985, 10 more were built and 55 buying points were set-up. By 1991, there were 74 GMB depots, of which 37 were in communal areas.

The number of Cotton Marketing Board (CMB) depots similarly rose from 5 in 1980 to 16 by 1985.

Increased access to marketing outlets and greater availability of transport for products contributed to the dramatic increase in communal maize and cotton production in the 1980s.

Expanding smallholder credit. With independence, the Agricultural Finance Corporation (AFC), which previously provided credit only to commercial farmers, expanded smallholder credit. About 18,000 communal area farmers borrowed from the AFC in 1979-80; the number rose to a peak of 77,526 in 1985-86 and then declined to 40,000 in 1988-89.

The decline in the number of borrowers in the second half of the decade shows that, despite the AFC's successes, it still faced two major problems. One was that an increasing number of communal farmers defaulted on their loans, causing the AFC to become more selective in approving loans. The second stemmed from the bureaucratic delays in paying farmers on certain crop sales. The AFC is experimenting with group lending to reduce its overhead costs and the level of defaults.

Communal farmers bought 45% more fertilizer in 1985 than in 1980, partly because they had more credit available. Since they apply most of the fertilizer to maize and cotton, this helps explain the mini production revolution among communal farmers in the 1980s.

The number of commercial farmers borrowing from the AFC dropped from 2,233 in 1979-80 to 720 in 1989-90 although they almost doubled the total amount they borrowed. Commercial farmers increasingly have turned to private banks for seasonal loans and to AFC for long-term borrowing. The 720 commercial farmers still borrow several times more than the total amount borrowed by the 44,000 communal farmers.

Strengthening agricultural research and extension. In 1980, the government instructed the Department of Research and Specialist Services (DRSS) to increase its research on the problems of communal areas. The department responded by introducing on-farm research, surveying communal areas, and introducing new research programs on enterprises such as agroforestry and small livestock.

While no resounding new technology has emerged, a notable result of those new efforts is a better relationship between small farmers and researchers. A 1989 review by the International Service for National Agricultural Research concluded that DRSS is too centralized in commercial areas and is

structurally unsuited for communal area research.

The extension service also has been restructured and new links built to research for communal areas. Until 1981, the Department of Conservation and Extension provided extension for commercial farms and the Department of Agricultural Development catered to communal areas. In 1981, the two were merged into the Agricultural, Technical and Extension Service (AGRITEX).

The first major achievement of AGRITEX was increasing extension worker intensity by reducing the extensionist-to-farmer ratio from 1:1000 in 1980 to 1:800-850 in 1990. This was achieved largely by abandoning the elitist master farmer training approach and adopting group extension.

As part of a World Bank loan, AGRITEX has experimented with the training and visit (T&V) system. T&V has been widely recommended by the World Bank; it was rejected by AGRITEX leaders as a national model because they found it expensive, inflexible, and incompatible with existing extension methods.

Increasing maize and cotton production in communal areas. Again, the impressive increase in maize and cotton production by communal farmers after independence proved that, given a package of prime movers — sound technology, efficient and effective marketing and service institutions, and a favorable price and economic environment — smallholders can increase production dramatically.

Maize production in 1980 increased by 147% from the previous year's level because (1) the price was increased by 50%; (2) a short-season hybrid maize was introduced; (3) there was a good rainy season; and (4) more credit and fertilizer was available.

The increase in market access to GMB led to an increase in marketed output of maize by communal farmers from an average of 7% before independence to more than 50% by 1985.

Cotton followed a similar pattern with communal farmers outstripping their commercial counterparts in terms of production and marketing. By allowing communal farmers more direct access to CMB, they have continued to increase their share of marketed output. In 1985, communal farmers, for the first time since the early 1900s, produced and sold more cotton than their large-scale counterparts. By avoiding middlemen and agents, farmers got a higher price and received payment quicker from CMB than through cooperative societies.

Lessons for Africa

Zimbabwe's agricultural development experience provides valuable lessons and insights for policy-makers and donors in southern Africa, South Africa, and the rest of Africa. I will first discuss the importance of the political process to agriculture's well-being.

Political Support for Agriculture is Important. Agriculture is treated differently in the political process in the industrial countries than it is in most African countries. This difference is important in understanding Zimbabwe's agricultural successes and the agricultural stagnation in many other countries in Africa.

Most African countries tax agriculture heavily and use it as a national parking lot for the poor. At the same time, civilian and army-backed governments generally reinvest only a token amount of the tax revenues they extract from farmers back into rural institutions, infrastructure, and villages.

By contrast, virtually every industrial country subsidizes its farmers and urban consumers, provides food aid abroad, and still has chronic problems with agricultural overproduction. For example, the agricultural surpluses in USA and western Europe largely are the result of subsidy policies promoted by farm commodity groups with enormous political power. These include the grain producers in the USA and livestock producers in Europe.

A high percentage of new African governments from 1960 to 1990 have been dominated by top-down military, industrial, and urban political coalitions. Most organized farm groups have been excluded from the political arena and farmers have been taxed to generate public revenues to support the army, highly visible social services, and an array of government beer, textile, and bicycle factories.

This tax burden imposed on agriculture in Africa and other third world regions is staggering. A recent World Bank study of 18 third world countries over a 25-year period (1960 to 1984) revealed that the average tax burden on the agriculture sector was 30%. A study by Schiff and Valdés, published in 1992, reports that the average direct and indirect taxation of agriculture in three African nations was as follows: Cote d'Ivoire, 49.0% for 1960 to 1982; Ghana, 59.5% for 1958 to 1976; and Zambia, 46.3% for 1966 to 1984.

The practice of taxing farmers and excluding them from the institutions by which they are governed is common in the third world. John Kenneth Galbraith, in his book *The Culture of Contentment*, notes that "a poor peasantry, scattered across the landscape, working from dawn to dusk in order to live, can, with a little effort be controlled and politically disenfranchised".

In short, the politics of exclusion cuts to the heart of Africa's insufficient harvest. If African farmers are excluded from the political process, who will make the case in the national political arena for rural schools, higher farm prices, year-round feeder roads, rural electrification, and modern colleges and faculties of agriculture?

Farmer-led Initiatives Have Been Crucial. The first generic lesson that emerges from Zimbabwe's two agricultural revolutions is that farmer-led initiatives have been crucial to agricultural success.

White European farmers started to form regional farmer associations in the 1910 to 1920 period. The government actively supported these associations, especially in Mashonaland, as part of its strategy to gain autonomy from the British South Africa Company.

Later, during World War II, commercial farmers cooperated with the government in increasing food production in exchange for the passage of the Licensing Act of 1942. The Licensing Act mandated that all large-scale white farmers and ranchers buy a license from the newly formed Rhodesian National Farmers Union (RNFU).

Jeffrey Herbst, in *State Politics in Zimbabwe*, describes the passage of the Licensing Act in 1942 as a "stroke of organizational brilliance" because it assured the RNFU of finance (dues from farmers and ranchers), which allowed the "white farmers to undertake research and lobbying exercises of enormous sophistication and expense." The RNFU was renamed the Commercial Farmers Union (CFU) after independence.

Commercial farmers also made the political case for government investments in the prime movers from 1920 to 1950. During the global depression of the 1930s, Zimbabwe's economic policy shifted from laissez-faire to direct intervention and subsidies to support white commercial farmers. With government

support from 1965 to 1980, commercial farmers diversified away from tobacco and expanded the production of sugar, cotton, wheat, soybeans, coffee, tea, beef, and dairy.

Zimbabwe's two agricultural revolutions have not been simple technocratic exercises; political support for agriculture has been an essential ingredient of both. By contrast, in many other African nations, farm organizations are kept on short tether by the ruling party.

Food and agricultural policy in Africa will continue to be dominated by the interests of urban, industrial, and military coalitions if farmers and farm organizations have little voice in the political system. The policy lesson for other nations in Africa is the need to encourage farmers to develop farm organizations and make the case in the political arena for public investment in agriculture and rural communities.

Balance is Needed in Land Reform.
Africa can learn lessons on approaching the sometimes-contentious land issue from experiences in Zimbabwe and other countries. Zimbabwe has pursued a cautious approach to dealing with land since independence.

On the one hand, its caution can be applauded because Ethiopia's rush to nationalize land after the 1974 revolution and the subsequent introduction of state farms ended in disaster. And Tanzania's promotion of Ujamaa (communal) farming in the 1970s turned out to be President Nyerere's biggest policy mistake.

On the other hand, a cautious approach to land reform may work against new nations such as Zimbabwe, Namibia, or the new South Africa because the longer a new government procrastinates on the land issue, the greater the opportunity for commercial farmers and managers of state farms to lobby and make the case that large farms — private and state — are needed to ensure a reliable national food supply.

Experience in Zimbabwe and other countries that shows smallholders can compete with large farms if they have political support, access to technology and efficient farmer support services, incentive prices, and market outlets disproves the food supply argument.

Two important dimensions of the land question in Zimbabwe have not been adequately addressed in the current debate over land.

- The first issue is the economic justification for eventually replacing Zimbabwe's dual agrarian structure with a smallholder agrarian structure.

The economic case for land reform and a smallholder-dominated agrarian structure is supported by empirical evidence presented by Peter Dorner. He writes that "small farms generally have a higher value of output per unit of land and capital than do large farms."

Other researchers have found that small farms are generally more efficient than large farms because family members receive a share of the profits and therefore have more incentive than hired workers to work hard. Also, there are no hiring and search costs for family labor. And, unlike hired labor on large farms, each family member assumes a share of the risk in smallholder farming.

However, some commodities have special processing requirements that lend themselves to large farms and plantations. For example, cut sugarcane must be processed within 12 hours or the sugar is lost to fermentation. This explains why sugar factories in many, but not all, third world countries manage their own plantations and carefully stagger cane

planting and harvesting to keep the sugar factory operating throughout a large part of the year.

Also, bananas grown for export by sea must be put in a cold boat within 24 hours of their harvest to arrest further ripening. This explains why some of the world's largest banana companies own large plantations that are operated by hired managers.

- The second issue is the role of land policy in generating rural employment.

Because population is growing rapidly, the agricultural and rural nonfarm sectors will have to provide jobs for as many as 75% of all newcomers to Zimbabwe's labor force in the foreseeable future.

Land reform for smallholders is appealing because it can put more people to work in rural areas. This issue is important to policy-makers because the rural labor force will increase rapidly over the next two to three decades.

With the exception of sugarcane, bananas for export, and a few other crops, there is solid economic justification for land reform in favor of smallholders on the basis of efficiency and employment considerations.

Restructuring Institutions to Support Smallholders

There is a large gap between the theory and practice of following a smallholder road to development. Developing efficient farmer' support organizations to assist hundreds of thousands of smallholders involves complex problems.

We have seen that, in a little more than a decade since independence, Zimbabwe has achieved mixed success in modifying its farmer-support institutions such as research, extension, and credit to assist smallholders.

Agricultural Research Faces Formidable Challenges. Agricultural research is a critical service for farmers. It should be broadly defined as the capacity to borrow, adapt, and generate new technology to increase the production of food, livestock, and export commodities that can generate new income, rural employment, and foreign exchange earnings.

DR&SS faces formidable challenges in implementing its mandate to give priority to the needs of communal areas:

- It needs to develop a feasible and cost-effective research strategy for agroforestry, small ruminants, horticulture, and non-traditional exports.
- It may need to establish several research stations in the heart of communal agriculture. Because of the over-centralization of research stations in the fertile natural resource regions, DR&SS is not well positioned to carry out research in communal areas.
- Conditions of service need to be improved; the turnover of research staff is high because of poor conditions of service.
- The government needs to restore financial support to DRSS and rebuild its human resource base. Zimbabwe's agricultural research system is under severe stress because of (1) the 25% reduction in its real (inflation-adjusted) budget from 1980 to 1990, (2) its rapid staff turnover, and (3) the difficulty of developing improved technologies in heterogeneous research environments.

Farmers Need Extension and Credit too. Taking the results of research to farmers is important. AGRITEX is experimenting with a number of practical alternative approaches to extension. It is trying to reorient its methods to better serve the communal farmers, including altering extensionist-farmer ratios

and putting greater emphasis on cost-effective ways to serve groups of farmers.

Credit is the third critically important farmer service. Although AFC responded magnificently to helping communal farmers increase their access to credit in the first half of the 1980s, it was unable to manage efficiently the quantum jump in the number of loans from 18,000 in 1981 to 77,526 in 1986. Other countries also are grappling with the complex issue of providing credit to large numbers of smallholders in a cost-effective manner.

In restructuring farmer support institutions to assist smallholders we need to consider how development institutions can interact with each other. The common donor-financed project-by-project approach to strengthening one institution at a time fails to exploit the spillovers, synergies, and linkages in a system of institutions.

Social Science Research Has a Role.

More social science research is needed on such institutional issues as

- the optimal public-private arrangements in agricultural research and seed delivery systems
- the most effective ways for nongovernmental organizations (NGOs) to assist in agricultural, rural development, and environmental programs in rural Zimbabwe
- the trade-offs in alternative extension models
- ways to develop cost effective and sustainable credit institutions to serve farmers in resource-poor areas

Finally, researchers in Zimbabwe can benefit from exchanging ideas on how other countries in southern Africa are serving farmer support institutions.

Policy Issues in Supporting Smallholders

Zimbabwe's smallholder cotton success story adds important empirical information to the ongoing policy debate over the roles of food crops and cash crops in African development.

Cash- vs. Food-crop Debate Continues.

Many academics and members of the donor/NGO community contend that cash crops are the "mother of poverty," and that they exacerbate hunger by diverting land and labor away from food crops. For example, Walter Rodney's widely read polemic, *How Europe Underdeveloped Africa*, makes a powerful case against producing cash crops for overseas markets.

But yesterday's experience is not an adequate guide for making current policy decisions on whether to produce food, or cash crops, or both.

There now is solid evidence in many African countries that cash crops, such as cotton, cut flowers, and horticultural products, can improve the lives of smallholders. Clearly, cotton has helped thousands of poor farmers in Zimbabwe increase their food buying power, pay school fees, and finance investments in oxen and equipment that have been useful in producing food. But it would be irresponsible to lay down a blanket policy guideline for or against cash crops in Africa.

Policy Mistakes Cut Maize Output.

Zimbabwe's smallholder food-production success story from 1980 to 1985 unraveled in the second half of the 1980s and during the epic drought of 1992.

There is clear evidence that the 1992 food (maize) crisis was not simply caused by drought. Rather, it was caused by drought and a combination of policy mistakes,

including a 25% reduction in real (inflation-adjusted) maize producer prices from 1985 to 1991. This sharp reduction in prices reduced farm profits and contributed to a reduction in the area planted to maize.

The area that smallholders planted to maize increased in the early 1980s, peaked in 1985, and then declined at an average rate of 55,000 ha per year from 1985 to 1991. Most of the decline in smallholder maize cultivation occurred in the lower rainfall areas, thus contributing to household food insecurity in these areas.

The government indirectly contributed to the 1992 maize crisis by failing to heed the early warnings of maize shortfalls by experts and making timely purchases of maize from overseas firms.

Zimbabwe's mistakes in managing its food economy from 1985 to 1992 point out how difficult it is for a new government to develop the capacity to deal simultaneously with short-term food emergencies and long-term food supply issues.

Long-term issues include maintaining incentive prices for farmers, generating a stream of new technology, restructuring farmer support institutions to serve smallholders, and managing a national grain reserve.

Development Thrusts Change.
Development is a long-term process that unfolds over decades, generations, and centuries. Nevertheless, the North-South development dialogue has been dominated by a succession of short-term development thrusts that have originated in Washington, Rome, Brussels, and Paris.

Over the past three decades, these development thrusts have included economic growth in the 1960s, integrated rural development in the 1970s, structural adjustment in the 1980s, and sustainable development in the 1990s.

About two-thirds of the nations in sub-Saharan Africa currently are implementing structural adjustment programs to improve macroeconomic policies, reduce the size of government bureaucracies, and increase the role of the private sector and reliance on market forces. In most cases, structural adjustment loans have been cast in a short-term time horizon of 5 to 10 years. Zimbabwe has been implementing a structural adjustment program since 1991.

The World Bank and many other donors have offered structural adjustment loans to African nations as an incentive to carry out badly needed policy reforms. But a structural adjustment program

- is not a substitute for a coherent and balanced long-range national development plan
- is not a substitute for a national agricultural development strategy
- does not embody political muscle, which is vital to the success of the reforms because, ultimately, successful structural adjustment or policy reform is a complex political bargaining process

It is instructive to examine Senegal's experience because, in 1980, it was one of the first African countries to receive a structural adjustment loan. A decade later, an evaluation mission concluded that most of the policy reforms in Senegal were postponed in the 1980s because of "the aid environment within which reform has operated."

The generous flow of foreign aid to Senegal during the 1980s allowed the government to postpone the policy adjustments and the tough political decisions that had been agreed upon in 1980.

Elements of a Third Agricultural Revolution

There now is a need for agricultural policy-makers and planners in Zimbabwe to move beyond structural adjustment and develop a strategy for a third agricultural revolution. Institutional and policy reforms should be aimed at the majority of the rural people — the 700,000 smallholders and the tens of thousands of microenterprises that are scattered across Zimbabwe's rural landscape.

This strategy calls for Zimbabwe to put its political muscle, policy attention, and government expenditures behind creating an agricultural revolution aimed at increasing rural production and employment in both the agroclimatically favored and the low-rainfall areas of the country.

Success of this strategy depends on strengthening the prime movers of agricultural development, carrying out land reform with aggressive government leadership, and implementing market-oriented macroeconomic policies.

Smallholders Form the Revolution's Centerpiece. The centerpiece of this third agricultural revolution is smallholder-led agricultural growth. There are four interlocking elements of the new revolution:

- The first is expanding food production, especially maize, because it accounts for about half the calories in the average diet in Zimbabwe.

  The immediate priority is increasing maize production in favored areas; it is a proven strategy with low risk.

  The 10- to 15-year emphasis should be to breed better maize, sorghum, and millet varieties and develop accompanying crop management practices for use by smallholders in resource-poor areas. Further, Zimbabwe's road and transport system must be improved and fertilizer distribution must be strengthened.

- The second element of a new agricultural revolution consists of policies, programs, and support services to expand the production of traditional exports such as cotton and tobacco. These generate rural employment, government revenues, and foreign exchange earnings.

- The third element is expanding nontraditional exports such as cut flowers, horticultural products, ostrich hides and meat, and crocodile products, recognizing that the export market for horticultural products and cut flowers will be intensely competitive in the 1990s.

- The fourth element is expanding rural nonfarm activities, such as small-scale industry, trading, and micro enterprises. A new agricultural production revolution will be unable, by itself, to eliminate rural poverty. The agricultural technology/smallholder road to development will work only if rural households that have adequate land and resources (such as credit, draft animals, and access to markets) to adopt new technology and employ all available family labor in farming.

Rural People Without Land Need Help. Rural households without adequate land or resources must be assisted by special food-for-work programs and food safety nets, plus investments in health and education to equip them to eventually migrate to the industrial-urban sectors.

Experience in Asia has shown the green revolution couldn't solve rural poverty problems without a long-run expansion of rural nonfarm jobs, rural to urban migration, and economy-wide growth. Policy-makers in southern Africa can glean policy insights from Asia's experience with rural poverty over the past 30 to 40 years.

Inderjit Singh's pioneering study of combating rural poverty in six countries in south Asia reveals that economic growth can reduce rural poverty in the long run, but antipoverty programs are needed in the short run.

Singh recommends helping smallholders expand noncrop enterprises such as dairying, small ruminants, fishing, and forestry. He points out that one crossbred cow may do more to raise the standard of living of landless households than giving each of them two to four acres of irrigated land in most parts of India.

Zimbabwe Faces Continuing Challenges. The 1990s will continue to be a competitive decade for Zimbabwe's farmers and marketing firms. South Africa is mounting an aggressive campaign to sell its technology, such as seeds, and agricultural products throughout southern Africa.

Moreover, farmers in Zimbabwe and other southern Africa countries are under increasing pressure from more technologically advanced competitors in Asia. For example, Africa currently is importing about $US 650 million of rice each year, mostly from Asian countries ranging from Pakistan to Thailand and Vietnam. Africa is currently importing three-fourths of all the wheat consumed on the continent. China is now a formidable competitor in world cotton trade.

Whether the Government of Zimbabwe can master the complex issues involved in meeting the challenge of a third agricultural revolution is an open question. Again, much will depend on its ability to free agriculture from the State, implement an ambitious land reform program, rebuild its agricultural research system, generate improved technology for resource-poor regions, and strengthen farmer support organizations to serve hundreds of thousands of smallholders.

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SASAKAWA GLOBAL 2000
SG 2000

Policy Recommendations

The final workshop session dealt with policy recommendations and issues. Introductory presentations were made by Olusegun Obasanjo, former head of state, Nigeria, and chairman, Africa Leadership Forum, and G. Edward Schuh, dean of the Hubert H. Humphrey Institute of Public Affairs, University of Minnesota, USA, and chairman of the Global 2000 Agricultural Council of Experts.

Mama N'Diaye Adamou, Minister for Rural Development and Cooperative Action of the host government, the Republic of Benin, thanked the participants with a parting presentation, and Norman E. Borlaug, President of the Sasakawa Africa Association, closed the workshop.

Comments by Obasanjo

To me, this workshop's uniqueness lies in its composition. It is composed of people from the research community, from the donor community, from resident communities, from agricultural practitioners who are close to the farmers, and from high government functionaries. So we can reasonably be assured that the recommendations we come up with at the end of this exercise will be utilized rather than be left to gather dust on the shelf.

Our ability to embark on agricultural development and on other economic ventures in Africa is predicated on peace, political stability, and social harmony within our different societies. Without these, and security, I believe that development can only be a dream. We, and by that I mean we Africans, are the architects of our fortunes or our misfortunes.

Technology is Available to Improve African Agriculture. When all is said and done, I believe also that there is general agreement that the technology to improve, increase, and sustain African agriculture is readily available and accessible. What we seem to be unsure of and undecided about is the system to support the technology. Here is where we have too many prescriptions — some in conflict — and, in the meantime, the patient is at the point of death.

The World Bank, some in the donor community in the North, and those I refer to as 'born again' environmentalists in the North, may be well meaning, but they should not sacrifice our existence or indeed our survival on the altar of their so-called good intentions. We must determine our agenda, which must be consistent, stable, and based on our needs and our outlook, not reflect the desires and wishes of our donors.

Although the beast of the structural adjustment program has been over-flogged, we need to refer to it — especially now that the World Bank is becoming wiser — if only to underline the harm it has done and to prevent its recurrence.

The World Bank, rightly I believe, claims that alleviation of poverty is one of its cardinal aims in Africa. Without investment, our poverty will remain endemic. The market may create wealth but it is almost blind in the distribution of that wealth. We need to ensure social justice by preventing political action though the structural adjustment program. We need to ameliorate social injustice and poverty.

There are five essentials to improve the lives of the rural people. They are: improved seeds, additional nutrients, credit, markets, and mechanical or chemical labor-saving devices and/or animal traction. These essential elements must be available on-time and in sufficient quantity for African agriculture to develop.

It has been suggested that the word 'subsidy' stinks and we should use the word 'investment.' I would not object to that. There is need for public and private sector investment in these essential inputs to make them available and affordable and to ensure quality control. Even then, no universal solution can be prescribed. Each country's special situation must be considered to achieve maximum advantage and efficiency.

Fertilizer is Essential to African Farmers. In the absence of sufficient quantities of organic matter, fertilizer becomes indispensable. Farmers need help in determining the correct fertilizer recommendation and they need to be educated in the most cost-effective fertilizer use. Bulk purchase at the national level and cooperation in fertilizer purchases among African countries may reduce fertilizer cost to individual countries, which can pass the savings on to the farmers.

Environmentalists are concerned about the use of fertilizer and other chemicals in agricultural development in Africa on the basis of pollution. I am not unconcerned by the danger to the environment through pollution. However, pollution caused by excessive fertilizer consumption is more devastating in the North than that caused by African farmers trying to eke out two square meals a day.

We Need to Make Farming More Attractive. As long as farming remains, at best, marginally rewarding, young men and women will drift away from the rural areas to increase the battalions of urban poor. The idea, therefore, that African agriculture should be based only on a half hectare holding is, to say the least, unappetizing and may remain so for some time.

I want to see people encouraged. I want to see the evolution of young, emergent, commercial farmers who will be holding, not half a hectare of land, but 5 to 10 to 20 hectares of land and for whom the city will have no big attraction.

Comments by Schuh

The title of this session implies that there has been agreement on a set of policy recommendations. I propose that, alternatively, we identify policy issues and discuss them.

This has been a highly diverse program; we have addressed many issues coming from many different perspectives. There is merit in going back and thinking about the Sasakawa Global 2000 (SG 2000) project, what it is, how it fits, and use that as a basis for opening up some policy issues.

New Production Technology is Critically Needed. I want to stress the overwhelming importance of introducing new production technology into agriculture and I will discuss three dimensions of it.

It is a powerful source of economic growth. New production technology is such a powerful source of economic growth — especially where agriculture is as important as it is in all African countries — because its benefits are widely diffused. We think the producer captures most of the benefits, but they ultimately get passed on to the consumer in the form of lower prices and those lower food prices are equivalent to an increase in real income.

There is hardly any other way you can benefit so may people. I always argue that the importance of agriculture is not due to the fact that it accounts for 40% of the gross domestic product or 80% of foreign exchange or 60% of the labor force; it is due to the fact that everybody eats food. That is why agriculture is an important sector even in the highly developed countries.

Another part of the story is that, if by introducing new production technology you lower the price of food, you benefit poor people relative to middle- and upper-income people. This is particularly true if you focus the technology on producing staples, as we do in SG 2000.

It is a cheap source of economic growth. Most studies that estimate the social rates recurrent to agricultural research show that, if the technology produced is adopted, the rates of return range from 30% to 35% up to 80% to over 100% or 120% in perpetuity. A small investment generates many income streams.

This is a critical point for policy-makers and donors. If you look around the world you will find that the donor agencies like the World Bank, the regional development banks, and the US Agency for International Development are all turning away from agriculture. They are turning away at precisely the wrong time.

It helps a country become more competitive. New production technology increases a country's competitiveness on both the import and export side. Most African countries are both importers and exporters.

With so much foreign aid coming into most African countries, the consequence is to give them strong currencies. This means that food can come in at a low cost of domestic resources.

Much of the foreign aid that is coming has food aid on top of it. So domestic producers have to compete with these foreign imports. The key to helping them compete is to raise their productivity so they can produce food at a lower price and still make a profit.

Those are three reasons it is important to modernize agriculture by diffusing the production technology and getting it out into the sector as the SG 2000 project does.

SG 2000 Involves Broad Policy Aspects. Let me briefly characterize the SG 2000 project. We heard both Norman Borlaug and Chris Dowswell describe it as an extension project. They even describe it as a rather limited extension project; as one designed to transfer available technology to farmers' fields.

There is nothing mechanical or simple about that process. It involves identifying the technology, training extensive staff on its adoption, and having the extension field staff show farmers how to use it. There also is a modest applied research program associated with the project in most countries.

This technology typically involves improved varieties, modern inputs such as fertilizer and pesticides, improved agronomic practices, and credit. The goal is to increase agricultural output and the incomes of farm families. The focus is on small producers. I think we need to keep this brief characterization of the project in mind as we identify some policy issues and their context.

Those who conceived and designed SG 2000 see it leading to may other things having to do with policy.

SG 2000 Can Play a Catalytic Role. The SG 2000 designers envisage the project as playing a catalytic role in the economy. They

expect it to demonstrate to farmers what new production technology can do. If you can do that, then you will increase farmers' demand for a continuing flow of new production technology, which will generate pressure on policy-makers to keep that flow coming, along with an effective extension service to deliver it.

They also expect the project to raise many ancillary questions. I have been struck by this almost from the first of these conferences and from my first conversations with Norman Borlaug about the project. The ancillary questions have to do with such issues as

- whether product markets can absorb the increased output
- whether suppliers can deliver the modern inputs
- whether credit will be adequate
- whether there be enough new technology coming along behind what is being implemented
- whether farmers have the skills and the ability to adopt the technology
- whether the land tenure system provides producers with adequate incentives to adopt the technology

These issues indicate the potential of the flow of production technology — in getting much of it adopted, having the process generate investment and reforms and changes around it, and leading eventually to transforming the rural agricultural sectors in these countries.

We want to focus on what is needed to keep this process sustainable and moving ahead. A number of features characterize this context — the economic environment in which these projects are being implemented. I want to focus on two.

Policy Reform and Structural Adjustment Affect Economies. First, there is a great deal of policy reform and structural adjustment — as defined by the World Bank, the International Monetary Fund, and other international donor agencies — taking place in Africa today. You recognize them when you see them and you swear at them when they go walking by!

This concentration on policy reform means that exchange rates are being realigned and pushed towards more realistic bases, protection of the domestic economy is being lowered and equalized across sectors, and domestic terms of trade are being shifted in favor of agriculture for the first time in a long time.

Dependence on Markets Increases. The second policy shift to note is a greater dependence on markets, both for allocating resources and distributing income. That means that some privatization is taking place and the private sector is being encouraged.

Not all of these changes are under way in every country. Individual countries are in different stages of these processes and policy-makers still vary a great deal in their commitment to them.

Most people agree that nobody likes these reform processes, they are painful, and they take time. People promise magic from them and there is no magic about them. But the reform process characterizes the African scene and we need to recognize that fact in the context of the more general policy reform process.

Technology Policy Interfaces with Economic Policy. Another set of policy issues deals with the relative prices being reflected to the producers and consumers. Are they efficient prices? If you want the technology to be adopted, you have to have

incentives. The most effective incentives are to have these prices right. This is the key to efficient economic growth and also the key to getting the technology adopted.

Science and technology policy on the one hand interfaces with economic policy on the other hand. They are highly complementary. You can have a productive new technology, but if is not economic for farmers to adopt it, they will not; they are not stupid. So you have to get the prices right to get the technology adopted.

Relative prices include the product prices and the prices of the modern inputs, such as fertilizers and pesticides. What struck me in the discussion of issues surrounding these relative prices, was that we tended to focus on fertilizer; its price, its availability, whether it had the right mix, and that sort of thing.

We said almost nothing about commodity prices — whether they were efficient, whether they were at the right levels, and so on. We also said virtually nothing about wage policy or about land policy, which is a component that tends to be highly complementary to technology policy and to whether the technology gets adopted.

Investment Policy Affects Capital Flow. An important set of issues relates to investment policy — the inflow of capital from abroad and the generation and mobilization of private domestic saving, we need to think about whether the foreign aid flows are too large in many African countries. I realize that may be viewed as heresy by many.

I was reminded of the issue not long ago when I was in an African country whose GDP was $1.3 billion and in which the foreign aid inflow was $1.1 billion a year. That much foreign aid can be very destructive. It can make developing agriculture almost impossible, because that much foreign aid makes a very strong currency, which means it is a tax on agriculture and a strong subsidy on imports. You provide the incentive to bring food in to compete with your domestic producers.

This circles back to the point that, if you can get dramatic improvements in the level of technology, you will be able to compete against that kind of foreign aid. Incidentally, much of that foreign aid was in the form of food aid coming into the country. You did not have to travel far and talk to many people to realize the enormous dependency that is developing as a consequence of that much foreign aid.

If any country is serious about developing its agriculture, it ought to use food aid to help poor urban consumers go through this transition period.

After a lengthy discussion with a finance minister who has no interest in seeing foreign aid reduced, I finally asked him, "Suppose that on Monday morning it was announced that all foreign aid to this country would stop, what would happen?" He said, "Oh, the exchange rate would go through the roof."

We tend to think about low-income developing countries as having weak currencies. But a lot of foreign aid coming in relative to the size of the GDP will give you a strong currency, which can create difficulties for most of your economy.

Countries Should Set Their Own Agendas. Let me make one other set of controversial comments. We hear repeatedly about the donors having their own agendas and not coordinating. A number of people say, "What we have to do is to get the donors to coordinate." I just wish them lots of luck because I do not think it is going to happen.

The only solution to this problem is to set your own agenda. You have to get your priorities sorted out and decide where and how you want to use foreign aid; then you are in a position to negotiate with the donors for the right kind of foreign aid for the right kinds of things.

One final set of pervasive issues that we talk a lot about without much consensus is what goes into the private sector and what goes into the public sector. I become rather frustrated with some of the ideology on this issue; from those who think you should privatize everything and those who think everything should be in the public sector. We all know that there are important analytical questions in determining the division and that is where we ought to focus the discussion.

We have had little experience in trying to get parts of the economy that are in the public sector back into the private sector. It is an opportunity where we have to be more creative.

The chairmen then opened the floor for participant comments and dialogue. Some highlights of the exchange follow.

Participant: My comments are related to research and extension issues. Introducing the improved practices, including fertilizer application, may be the appropriate strategy for several environments where the market for capital inputs are right. In marginal environments, the modern system is wrong, simply because the marginal increase in productivity from fertilizer and improved varieties is not right.

We need to place more emphasis on internal inputs, the addition of organic matter in the soil and, maybe, the development of suitable varieties rather than hybrid seed.

Another area of concern is that most of the food produced on the small agricultural holding in Africa is consumed at home and there is evidence that postharvest losses are high, something like 25%. We need to address that problem since food security starts at home.

Another issue was women in development. All of us can find some statistics in post evaluation of our projects to claim that women were involved in our activities or processes. But most of the time that has been by chance, not really by design. We need to target women from the beginning — in the design of our projects — not just let their participation happen by coincidence.

Another point relates to the choice of investment between low-input agriculture, like dry-land farming, and irrigation agriculture, with its high input intensity. Irrigation agriculture is expensive, with many external inputs and a high foreign exchange component. We need to be guided by comparative advantage and promote specialization and efficient trends.

A final point relates to the issue of retaining human resources and building the capacity of African institutions. That is a real challenge and very complicated. I suggest promoting or providing incentives for Africans with needed expertise to come and work on African development problems. We need to recruit more Africans in the international agencies that are working on development in Africa.

Schuh: I'd like to make one comment on the women in development issue. One problem is that we know too little about the household. We tend to think about the production unit and we need to consider also the family household. We know little about how women participate in farm activities, how other members of the family participate, and what the men do with their time. We need research

as a basis for developing a sounder policy for facilitating women's adoption of new technology.

Participant: I would like to comment on financing of technology, one of the specific issues you raised. We can look at financing and technology at the donor level, at the macroeconomic level, at the government budgeting level, and at the farmer level.

It is important that donors have a clear idea of the adequacy, the duration, and the financing mechanics of a particular activity. We have seen many examples of projects in Africa that donors have either underfunded or overfunded, resulting in projects being terminated too soon or remaining too long in the field.

At the macroeconomic level, we discussed the availability of inputs to the farmer. One of the great challenges is having the foreign exchange available to buy the purchased inputs. Governments need to have macroeconomic policies in place to assure that foreign exchange is available to buy the inputs, be they fertilizers or other chemicals or even seed.

The government budgeting process comes into play in that successfully introducing technology at the smallholder level requires a lot of investment that is outside that particular transfer of technology. Central government budgets need to adequately provide funds to support the rural infrastructure, rural health, and rural education, all of which are important.

At the farmer level is the fact that, for technology to be successful and become sustainable, it must be socially beneficial and provide an opportunity for the farmer to make a profit. A policy question is: Should the focus be on the poorest of the poor, who may not be the most efficient or quickest users of the technology, or on the more progressive, emergent farmers who will adopt it more quickly? The answer is affected by the financial requirements of the technology we are transferring.

Further, we need to consider farmers both as savers and as lenders in talking about rural financial institutions. We tend to think that low interest rates favor farmers. In fact, farmers can benefit more with market interest rates, especially the emergent farmers.

On the subject of subsidies — or investment as it was called — in introducing a technology, the investment should have a time frame and should not be there in perpetuity. The reason is that, in Africa, where agriculture accounts for more than 40% of the average GDP and for 60% to 70% of economic growth, it is impossible for any other sector to subsidize such a big sector. If there have to be subsidies in agriculture, they must be selective and be of a specific duration.

Comments by N'Diaye-Adamou

Mama N'Diaye Adamou offered the following comments and recommendations on behalf of the delegation from Benin's Ministry for Rural Development:

Our workshop is now near its end. Allow me to express my satisfaction about the quality of the dialogue, which is essentially a reflection of the quality of the participants, most particularly the distinguished lecturers. We have learned a great deal during this workshop, just as during previous ones.

Certain things are obvious. Many challenges remain in the rural sector and problems multiply as we continue our efforts each year. The persistence of problems may be due to the inefficiency of our policies.

Money is Not the Only Important Factor. What matters is not always the amount of money committed to a development activity but rather the approach taken: how the priorities are determined and the programs devised; whether the problems of rural communities are genuinely taken into account; and how each of the participants plays his or her part.

In the context of this workshop, our recommendations take the form of an appeal to the international and bilateral institutions, particularly the NGOs, that are our partners. We want to be more pragmatic.

In this connection, I reiterate my proposal made at Airlie House, Virginia, USA, in 1992 that the conclusions of our discussions be circulated widely (1) to further the workshop's contribution to solving the problems affecting the rural world and (2) to appeal to individuals of good will who have not accurately assessed the magnitude of Africa's rural development problems.

Africans have to consider many issues and fight on several fronts at once: attaining food security; protecting the environment; making export products competitive; improving rural incomes; mopping up unemployment among the young; combating the exodus of rural people to the cities; and improving the socioeconomic integration of women and making their work easier. In other words, developing rural areas.

Africans Need to Take Stock of Challenges. Africans themselves have a first-class part to play in taking stock of all these challenges and working harder to meet them. The support of the international community then will make it possible to achieve better results.

In light of these points, the following activities seem fundamental:

- Developing basic infrastructure such as rural roads, warehouses, water supplies in villages and nomadic areas, and markets.
- Improving the living conditions in rural areas by developing biomass energy systems to provide electricity from local resources such as agricultural by-products.
- Training, educating, and raising public awareness of the need to adopt a more wholesome approach to managing the environment.
- Devising coordinated research, training, and extension programs in the best-performing systems of production.
- Developing information and early-warning systems to deal with emerging problems.

Recommendations to decision-makers should emphasize the importance of providing appropriate support for agriculture. Despite its recognized priority status, it often gets minimal funding.

Donors Need to Allow Time for Change. Speaking in general terms to our partners in development, I stress the need for allowing sufficient time for Africa to take off. Often, we think that 2 or 3 years are enough time to run an experiment and attain conclusive results. We may overlook the multidimensional aspects of development activities. When it comes to transferring know-how or technology to rural populations, many efforts and much time are required.

We are involved in programs that must be well rooted before donors disengage. This is necessary in a rural environment, dealing with biological reality and local people who are not always properly trained. Withdrawal often occurs at the moment when the operation

seems to be catching on. This is one of the causes of failures.

For the benefit particularly of SG 2000, I would like to pass on the wish expressed by some farmers as I was leaving Gbowimé in Mono — the village that we visited. They said, "We think you will be with us in the years to come?" I replied, "Certainly".

They continued: "We are talking about the government and our visitors." I replied that there was no problem. I then inquired why they were so anxious. The farmers replied that very often the help is suspended just when they embark on the path of change.

In telling this little story, I am voicing a wish that surely is shared by other participants: that in the context of the SG 2000 project, we cannot stop at such a promising moment.

Comments by Borlaug

Borlaug closed the recommendations session, which concluded the workshop, with an historical overview of genetic achievements in wheat and other crops and related technological and policy developments that led to the introduction of the SG 2000 project.

Among other points, he lent perspective to the pressure of environmentalists to restrict or eliminate use of fertilizer and other chemicals in food production. Some of his comments follow:

On the subject of chemical fertilizer, some people in the environmental movement will insist on calling for a natural, rather than synthetic, chemical; but Chile nitrate obviously was washed out from somewhere and probably fixed, in part, by lightning. Chile nitrate deposits were the first to be used commercially on a large scale. Of course, bird guano was used in many parts of the world, but it was present only in small quantities.

When we talk about phosphate, where did those deposits come from? They were leeched out of the land over long periods of time and precipitated. Now we bring them back to restore fertility to the soils that are short of phosphate.

Let us not become confused by many of these rabid anti-chemical, anti-fertilizer people. As a matter of fact, we scientists are guilty of letting this get out of focus. We did not speak out. We thought that this would go away. It started with "Silent Spring" and the DDT issue.

Chemical companies began to take the name "chemical" or "chemistry" off their labels; "better things for better living" once included the words, "through chemistry." They are no longer there.

Scientists Need to Speak Out. Unless we start speaking out, we will have more of this trouble and we will indirectly and inadvertently contribute to the collapse of the food system. Remember that, today we are 5.5 billion people. During my lifetime, the population has grown from 1.6 billion to 5.5 billion. Worse yet, at the present time it is increasing by one billion more people each decade. To feed these people, we must apply what we now know and we must move science and technology forward.

This is why the Sasakawa Africa Association is here in Africa — to try to apply much of the research information that has been developed but has not been moved to farmers' fields for many reasons.

Without fertilizer and without the use of all the inputs we have to have, we will not make it on the food front for very long. It is up to each and everyone of you to have enough courage to speak out or we lose by default, and if that happens, each of you is responsible.

Workshop Participants

Adamou-N'Diaye, Mama
Minister of Rural Development
Cotonou, Bénin

Adams, Paul
Journalist
The Financial Times
London, Great Britain

Agbodji, Jacques
Resident Representative
United Nations Development Program
B.P. 506
Cotonou, Benin

Agle, Andrew
Director of Operations
Global 2000 Inc.
The Carter Center
Atlanta, Georgia, USA

Ahanhanzo, Glélé Adrien
Technical Advisor Ministry of Planning
Cotonou, Bénin

Akibo-Betts, David
Senior Agronomist
Sasakawa Global 2000
Dar-es-Salaam, Tanzania

Alemayehu, Awetahegn
Vice Minister
Ministry of Agriculture, Environmental Protection and Development
Addis Ababa, Ethiopia

Ametitovi, Folli
Director of Agricultural Credit
Ministry of Rural Development
Lome, Togo

Antoine, Pierre
Director
Africa & Middle East Division
Winrock International Institute for Agricultural Development
Morrilton, Arkansas, USA

Assiongbon, Ekoué K.
Director General
Ministry of Rural Development
Avenue de Sarakawa
Lome, Togo

Ben-Musa, Salihu
Managing Director
Hadeija-Jamara River-Basin Development Authority
Kano, Nigeria

Berhe, Tareke
Senior Agronomist
Sasakawa Global 2000
Accra, Ghana

Bonte-Friedheim, Christian H.
Director General
International Service for National Agricultural Research
The Hague, The Netherlands

Borlaug, Norman E.
President
Sasakawa Africa Association
México City, Mexico

Bossou, Komlan
National Coordinator
Sasakawa Global 2000
Ministry of Rural Development
Lome. Togo

Brader, Lukas
Director General
International Institute of Tropical Agriculture
Ibadan, Nigeria

Bullard, Edward
President
TechnoServe Inc.
Norwalk, Connecticut, USA

Campbell, Lyall
Senior Agronomist
Sasakawa Global 2000
Kano, Nigeria

Carter, Jimmy
Former President of the United States of America
Chairman, Global 2000
The Carter Center
Atlanta, Georgia, USA

Carter, Rosalynn
The Carter Center
Atlanta, Georgia, USA

Chokki, Désiré
Sectorial Economist
African Development Bank
Abidjan, Côte d'Ivoire

Cissé, Babacar
Deputy Resident Representative
United Nations Development Program
Cotonou, Bénin

Cobb, Richard
Head, Africa Bureau
US Agency for International Development
Washington, DC, USA

Coulter, John
Former Scientific Adviser to the World Bank
Sussex, Great Britain

Critchfield, Richard
Journalist and Author
Berkeley, California, USA

Delimini, L.L.
Head
Ghana Seed Inspection Unit
Crops Services Department
Ministry of Agriculture
Accra, Ghana

Deola, Naibakelao
Africa Resident Representative
Sasakawa Africa Association
Accra, Ghana

Diagne, Gana
Resident Representative
Food and Agriculture Organization
Cotonou, Benin

Diggal, Gambo I.
Director
Monitoring and Evaluation
Kano State Agricultural and Rural Development Authority
Kano, Nigeria

Donkor, F.K.
Deputy Director
Agriculture Extension Services
Ministry of Agriculture
Accra, Ghana

Dowswell, Christopher
Director for Program Coordination
Sasakawa Africa Association
Mexico City, México

Doyen, Jean
Chief, Environmental and Sustainable Development Division
Africa Technical Department
The World Bank
Washington, DC, USA

Dresrüsse, Gunter
Director
Agricultural Services Division
Agriculture Department
Food and Agriculture Organization of the United Nations
Rome, Italy

Edache, O.A.
Director of Agriculture
Federal Ministry of Agriculture, Water Resources and Rural Development
Abuja, Nigeria

Endeley, Joyce
Senior Lecturer
Faculty of Agronomy
University of Dschang
Cameroon

Fagbohoun, Fortuné
National Coordinator
Sasakawa Global 2000
Ministry of Rural Development
Cotonou, Benin

Foege, William
Executive Director
Global 2000
The Carter Center
Atlanta, Georgia, USA

Foster, Michael
Acting Country Director
Sasakawa Global 2000
Arusha, Tanzania

Freeman, Horatio
Research Associate
SG 2000 Agricultural Council of Experts
University of Minnesota
St. Paul, Minnesota, USA

Freymond, Jean F.
Director
Center for Applied Studies in International Negotiations
Geneva, Switzerland

Fumagalli, Astolfo
Senior Agronomist
Sasakawa Global 2000
Accra, Ghana

Galiba, Marcel
Director for Benin and Togo
Sasakawa Global 2000
Cotonou, Benin

Ganmanvo, André
Director
Policy Planning and Analysis
Ministry of Rural Development
Cotonou, Benin

Gebre, Takele
Head
Department of Agricultural Extension
Ministry of Agriculture
Addis Ababa, Ethiopia

Goff, Thad
Country Manager
Cargill Nigeria
Lagos, Nigeria

Gyarteng, O.K.
Acting Chief Director for Food and Agriculture
Ministry of Agriculture
Accra, Ghana

Haag, Wayne
County Director
Sasakawa Global 2000
Accra, Ghana

Hardman, John
Executive Director
The Carter Center
Atlanta, Georgia, USA

Hassan, Rashid
Associate Economist
Economics Program
CIMMYT
Nairobi, Kenya

Havener, Robert
Former President
Winrock International Institute for Agricultural Development
Solvang, California, USA

Hayami, Yujiro
Professor of Agricultural Economics
Aoyama Gakuin University
School of International Politics, Economics and Business
Tokyo, Japan

Hebblethwaite, John
Director
Conservation Tillage Systems
The Agricultural Group of Monsanto
800 North Lindbergh Boulevard
St. Louis, Missouri, USA

Herren, Hans R.
Director
Plant Health Management Division
International Institute of Tropical Agriculture
Biological Control Center for Africa
Calavi, Bénin

Houadjeto, Grégorie
Director of Cooperative Action
Ministry of Rural Development
Cotonou, Bénin

Houssou, Moïse
Director
Directorate of Agronomic Research
Cotonou, Bénin

Iriyama, Akira
President
Sasakawa Peace Foundation
Sasakawa Hall
Tokyo, Japan

Jir, Mai M.
Director of Planning
Federal Ministry of Planning
Abuja, Nigeria

Kogblévi, Aziadomé
Technical Advisor for Rural Development
Office of the President
Cotonou, Bénin

LeMoigne, Guy
Senior Advisor
Agricultural and Natural Resources Department
The World Bank
Washington, DC, USA

Lele, Uma
Graduate Research Professor
Department of Food and Resource Economics
University of Florida
Gainesville, Florida, USA

Loustalot, Jean-Jacques
Head
Agriculture Department
Nestlé S.A.
Vevey, Switzerland

Maene, Luc
Secretary General
International Fertilizer Industry Association
Paris, France

Maier, Karl
Journalist
The Independent
London, Great Britain

Makweta, Jackson
MP, Minister for Agriculture
Ministry of Agriculture, Livestock Development & Cooperatives
Dar-es-Salaam, Tanzania

Minagawa, Masataka
General Manager
Sasakawa Africa Association
Sasakawa Peace Foundation
The Sasakawa Hall
Tokyo, Japan

Miyamoto, Masaaki
Program Coordinator
Sasakawa Peace Foundation
The Sasakawa Hall
Tokyo, Japan

Mokwunye, Uzo
Director
International Fertilizer Development Center
Lome, Togo

Moody-Stuart, G.H.
Director
Booker Tate Ltd.
Thame, Great Britain

Moyo, Engelbert
Assistant Commissioner
Head of National Extension Service
Ministry of Livestock. Development & Cooperatives
Dar-es-Salaam, Tanzania

Mule, Harris M.
Former Permanent Secretary
Ministry of Finance
Nairobi, Kenya

Mulele, Russell
Director of Agriculture
Ministry of Agriculture & Water Development
Lusaka, Zambia

Musa, Musa Mohamed
First Undersecretary for Agriculture
Ministry of Agriculture, Natural and Animal Resources
Khartoum, Sudan

Mutinga, Mutuku J.
Leader
Medical Vectors Research Program
International Center of Insect Physiology and Ecology
Nairobi, Kenya

N'Zamujo, Godfrey
Director
Projet Shongai
Porto Novo, Bénin

Nagai, Kazuo
Director
Forestry and Fisheries Development Study Division
Japan International Cooperation Agency
Tokyo, Japan

Nomédji, Nicolas K.
Minister of Rural Development
Lome, Togo

Obasanjo, Olusegun
Former Head of State of Nigeria,
Chairman, Africa Leadership Forum
Ogun State, Nigeria

Olowude, Samuel
Officer-in-charge
Africa Division
Project Management Department
International Fund for Agricultural Development
Rome, Italy

Orr, Patrick
Partner
Raitt Orr & Associates
London, Great Britain

Pehu, Eija
Head, Department of Plant Production
Faculty of Agriculture and Forestry
University of Helsinki
WIDAGRI Consultants Ltd.
Helsinki, Finland

Plucknett, Donald
Senior Scientific Adviser
Consultative Group on International Agricultural Research
Washington, DC, USA

Ponchaut, Laurence
Economist
European Community Commission
Cotonou, Bénin

Quiñones, Marco A.
Country Director
Sasakawa Global 2000
Addis Ababa, Ethiopia

Rukuni, Mandivamba
Professor
Department of Agricultural Economics and Extension
University of Zimbabwe
Harare, Zimbabwe

Sabi, Iyatan
Director of Extension
Ministry of Rural Development
Lome, Togo

Sakashita, Akira
Deputy Manager
Planning and Coordination Division
International Affairs Department
The Sasakawa Foundation
Tokyo, Japan

Sale, Imorou
Director of Agriculture
Ministry of Rural Development
Cotonou, Bénin

Schuh, G. Edward
Dean
Hubert H. Humphrey Institute of Public Affairs
University of Minnesota
Minneapolis, Minnesota, USA

Shonsey, Edward
Senior Vice President
Pioneer Hi-bred International Inc.
Des Moines, Iowa, USA

Swegle, Wayne E.
Consultant
Sasakawa Africa Association
Petit Jean Mountain
Morrilton, Arkansas, USA

Takagi, Koichi
General Manager
International Affairs Department
The Sasakawa Foundation
Tokyo, Japan

Valencia, José
Country Director
Sasakawa Global 2000
Kano, Nigeria

Vihma, Paivi
Economics Editor
Talouselama
Helsinki, Finland

von Haugwitz, Hans
Head Regional Division 011
GTZ
Eschborn, Germany

von Krogsik, Vollrat
Manager, Family Farm Sector
Lornho de Moçambique
Maputo, Mozambique

Wanjui, Joseph B.
Development Director
Middle East and Africa Division
Unilever Plc
Nairobi, Kenya

Wientjes, Henricus J.
Managing Director
WIENCO (Ghana) Ltd.
Accra-North, Ghana

Winkelmann, Donald L.
Director General
CIMMYT
Mexico City, México

Yamamoto, Eiichi
Lecturer
Gakushu-in University
Saitama, Japan


MINISTERE DU DEVELOPPE
SASAKAWA GLOB
PARCELLE TEST DE PF
VARIETE
VARIETY
BEN 86 052
DATE DE SEMIS
PLANTING DATE
11 - 05