From Subsistence to Sustainable Agriculture in Africa

Sasakawa Africa Association

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Papers from the workshop From Subsistence to Sustainable Agriculture: Policies, Strategies, and Implementation, held in Johannesburg South Africa, 18–19 November 2002.

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The workshop sponsors: The Sasakawa Africa Association sponsors the Sasakawa-Global 2000 agricultural projects in sub-Saharan Africa jointly with the Global 2000 Program of The Carter Center. The primary aim of those projects is to promote more effective transfer of improved technology to small-scale farmers. The Sasakawa Africa Association was established in 1986 by the Nippon Foundation, Tokyo. The New Partnership for Africa's Development (NEPAD) is a program of the African Union designed to meet the union's development objectives. The NEPAD secretariat coordinates implementation of projects and programs approved by the Heads of State and Government Summit of the African Union. NEPAD was created in 2001.

Abstract: This publication is the fifteenth proceedings of a series of workshops that address measures for improving sub-Saharan Africa's food security and other issues relevant to economic progress in the region. The chapters cover Africa's future food security outlook, Ethiopia's agricultural intensification campaign, Uganda's reforms in delivery of government services, Japanese agencies' support for a green revolution in Africa, capitalizing on Africa's plant genetic resources, utilizing best practices in African agriculture, Africa's declining soil fertility, innovations in developing water resources for smallholders, impediments to establishing input delivery systems, how the growth of agribusinesses can aid the poor, NEPAD's approach to African agricultural development, and the impact of HIV/AIDS development activities and outcomes.

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Contents

Foreword

Agriculture and rural development are again high on the agenda of African leaders and international agencies. They recognize that improved productivity in agriculture is central to the goals of reducing poverty and stimulating economic growth. This renewed attention should lead to increased investments in agriculture, and it constitutes an opportunity to reduce poverty and improve food security for millions of Africans. The question is, how can this opportunity be seized?

The strategy and the underlying concepts needed to improve the performance of agriculture in sub-Saharan Africa have been discussed for years. A consensus exists on many if not most of the policy components. Some aspects however are still debated. Among the issues in dispute are the importance of increased fertilizer consumption in smallholder food production and how to develop robust input-delivery systems capable of serving smallholder farmers in affordable and accessible ways. Accelerated development of integrated transport systems (roads, rail, and shipping) underlie all other efforts to development smallholder agriculture and rural sectors in Africa.

Past experiences have demonstrated, however, that the main challenge is to overcome the many obstacles to implementing this strategy: from lack of clear priorities to unavailability of funding and from feeble political will, which impedes, slows, or distorts the implementation of the strategy, to poor partnership and lack of clearly defined roles among public, private, and NGO stakeholders. An important challenge therefore is to develop more effective institutional arrangements that eliminate waste and apply existing resources in a concerted way that will achieve success and generate more support for positive transformation of agriculture. That is a shared goal of the New Partnership for Africa's Development and the Sasakawa Africa Association.

The New Partnership for Africa's Development (NEPAD) is a program of the African Union. It was created in 2001 to develop an integrated socio-economic framework for the development of Africa. NEPAD is dedicated to facilitating the development and coordination of more effective policies, strategies, and partnerships as well as harnessing its unique political leverage to overcome the continued poor performance of African agriculture. NEPAD considers agriculture a priority area for kick-starting initiatives aimed at eradicating poverty, accelerating the empowerment of women, stimulating Africa's economic growth, and enhancing the integration of the continent into the global economy.

For the last 17 years, the Sasakawa Africa Association (SAA) has been active in introducing yield-increasing, productivity-enhancing food production technologies to smallholder farmers. It works closely with ministries of agriculture, implementing its programs in concert with national agricultural development plans.

SAA and NEPAD jointly sponsored this conference to focus on how productivity-enhancing strategies and other key areas can enrich the NEPAD Agriculture Action Plan and define appropriate implementation approaches. The conference was organized by NEPAD and the Centre for Applied Studies in International Negotiations. It was funded by the Nippon Foundation.

Many people contributed significantly to the success of the conference, but it is appropriate to single out especially Dr. Wiseman Nkuhlu and his colleagues at the NEPAD Secretariat and Jean Freymond and his associates of the Centre for Applied Studies in International Negotiations.

Norman E. Borlaug, President
Sasakawa Africa Association

Glossary

ACORD	Agency for Cooperation and Research in Development
AIDS	Acquired Immune Deficiency Syndrome
CASIN	Centre for Applied Studies in International Negotiations
Danida	Danish Agency for Development Assistance
FARA	Forum for Agricultural Research in Africa
GDP	gross domestic product
GMO	genetically modified organism
GPS	global positioning system
HIV	human immunodeficiency virus
IFAD	International Fund for Agricultural Development
IFDC	International Fertilizer Development Center
IPGRI	International Plant Genetic Resources Institute
NAADS	National Agricultural Advisory Services
NEPAD	New Partnership for Africa's Development
NGO	nongovernmental organization
OECD	Organisation for Economic Cooperation and Development
PEAP	Poverty Eradication Action Plan
PMA	Plan for the Modernisation of Agriculture
SAA	Sasakawa Africa Association
SG 2000	Sasakawa-Global 2000
SIDA	Swedish International Development Agency
t	tonnes
USAID	U.S. Agency for International Development

Synthesis Report

The New Partnership for Africa's Development (NEPAD) is dedicated to facilitating more effective policies, strategies, and partnerships. It is an integrated socioeconomic framework for the development of Africa that was developed by five African heads of state and adopted by the Organization of African Unity (now the African Union) in 2001. Agriculture is identified as the priority area for kick-starting initiatives to eradicate poverty, stimulate economic growth, and empower women to ensure that African countries can be set on a path of sustainable development and participate effectively in the global arena.

NEPAD is determined to harness its unique political leverage to overcome the poor performance of African agriculture. Strategies to improve the performance of agriculture in sub-Saharan Africa have been discussed for years. A consensus exists on most of the key policy components. Some aspects, however, are still debated. One is the importance of increased fertilizer use by smallholder farmers. Another is how to develop delivery systems capable of providing the seed, fertilizer, agrochemicals, and pharmaceuticals required by smallholder farmers in affordable and accessible ways.

More effective institutional arrangements are needed to ensure efficient use of resources, eliminate waste, and apply existing resources in a manner that will ensure success and generate more support for transforming agriculture. New forms of public-private-NGO partnership are likely to play key development role. For 16 years, SG 2000—a joint venture of the Sasakawa Africa Association (SAA) and the Global 2000 program of the Carter Center—has been working with the governments in 14 African countries to demonstrate and introduce productivity-enhancing food production technologies to smallholder farmers. Frequently mentioned by national leaders as the NGO that works in closest collaboration with governments, SG 2000 assists ministries of agriculture in implementing national agricultural development plans.

Agriculture and rural development are again high on the agendas of African leaders and international agencies. Renewed attention to agriculture should lead to increased investments to reduce poverty and improve food security for millions of Africans. How can this opportunity be seized?

One strategy is partnering with organizations, including NGOs like SAA and Global 2000, to help disseminate and demonstrate best practices in smallholder agricultural production, natural resource conservation, and food market development.

This workshop, organized by NEPAD and SAA, with assistance from CASIN, is the first step in establishing the NEPAD/SG 2000 partnership, which will involve collaborative activities ranging from grassroots demonstrations of technologies to support of information-sharing events and activities and policy-related assistance and support.

Opening Statements

The workshop participants were welcomed by Jean Freymond (CASIN) and were urged to be ready for short, intensive, and, hopefully, fruitful deliberations.

The chairperson of the session, Hager Elislambouly (Ambassador of Egypt to South Africa), informed the participants that her country had been mandated by the NEPAD Heads of State Implementation Committee to coordinate the agricultural sector of the NEPAD initiative. She called agriculture the engine for general growth in every economy and urged the participants to rally around NEPAD to meet its agricultural objectives.

Akira Iriyama (Sasakawa Peace Foundation) representing Yohei Sasakawa, president of Nippon Foundation, noted that, with the exception of some oil-exporting states, "no country in the world has been successful in achieving economic success without developing its agricultural sector first." He urged the participants to be focused in their discussions and recommendations.

Wiseman Nkuhlu (NEPAD) provided a historical background on NEPAD. He urged the participants to aim at an African agricultural system that will reduce the incidence of hunger, lower food import bills, and encourage farm exports. He reminded the participants of the pledge made by African heads of state in Durban to rally African countries individually and collectively toward sustainable growth. Only Africans themselves can achieve this goal. This is what NEPAD is all about.

He also stressed the importance of creating space and an environment for people to be innovative and creative and of applying science and technology in research on sustainable growth. Prof. Nkuhlu concluded that "NEPAD is offering us all an opportunity to free our people from economic hardship and poverty but we need hard work to achieve all these noble goals."

NEPAD and Agriculture

Sunday Dogonyaro (NEPAD) summarized NEPAD's action plans on agriculture, which have already been approved by the African heads of state. A main objective of the NEPAD agriculture program is to redress the food security and supply situation in Africa, which has been deteriorating for more than a decade.

The strategy is to thoroughly transform agriculture in four key aspects:

- diversified agricultural products, methods, and techniques
- intensified land use to raise yields and increase agricultural productivity
- demand-led response to ensure better market access for products
- increased and sustained investments in research, agro-industries, capacity building, irrigation, and infrastructure

As part of the NEPAD Agricultural Action Plan, four strategic thrusts were formulated: extending the area under sustainable land management and reliable water control systems

- increasing food supply and reducing hunger
- improving rural infrastructure and market access
- increasing agricultural productivity and sustainability

The rationale, targets, specific actions, and resources required for each thrust have been established. The thrusts provide the basis for regions and countries to develop specific projects for implementation in the 2002–15 period. The total resources required for implementing these thrusts are estimated at US$192.7 billion, roughly equivalent to the annual food import bill of the continent over this period. Thus, in theory, a large part of these interventions could be implemented through import substitution. In practice this would be somewhat more difficult, and resources would also have to be obtained through official development assistance and

development partners like the United Nations and multilateral institutions.

The Challenges Ahead

In his paper, Norman Borlaug (Sasakawa Africa Association), observed that improved agricultural productivity is central to meeting the United Nations' millennium goals of poverty alleviation and economic growth. There is too much emphasis on theory and piloting at the expense of implementation and scaling up programs. Considerable amounts of improved agricultural technology (varieties and information) have been sitting on the shelf unused because of a lack of dynamic technology transfer programs.

Although sub-Saharan African nations face formidable agricultural development challenges, solutions lie in adopting productivity-enhancing agricultural technology. Higher productivity in the agricultural sector is vital for alleviating poverty and achieving sustainable economic growth.

A major hindrance in sub-Saharan Africa is nutrient mining. The rate of fertilizer used per hectare of arable land in sub-Saharan Africa is only a fraction of the rate used in other parts of the developing world. Integrated soil nutrient restoration strategies—involving organic and inorganic nutrient sources—are essential to getting agriculture moving. Managing organic matter in tropical soils does matter. Organic fertilizer, however, is not an alternative to chemical fertilizer, but rather a complement. Since China changed its adversarial policy toward fertilizer usage in the 1980s, its agricultural productivity has made quantum leaps.

The precautionary principle—the search for unobtainable perfection—is an obstacle to the use of new technology in sub-Saharan Africa. Governments seem to be shying away from both promising and proven technologies, as they become confused by environmentalist debates emanating from the rich industrialized countries. More useful lessons can be learned from the Asian countries. Dr. Borlaug traced the growth of agricultural productivity through the use of improved technologies, and clearly illustrated why this period became known as the green revolution era.

Good Practices: Ethiopia

Belay Ejigu (Vice Minister of Agriculture and of Rural Development, Ethiopia) pointed out that despite the current food shortages in Ethiopia, strong growth has been recorded in the agricultural sector. In 1991 a new government came to power in Ethiopia, which placed agriculture at the center of its economic development policy. It is important to recognize that Ethiopia consists of three distinct environmental regions: areas with adequate moisture, food-insecure areas, and pastoral areas. Considerable success has been achieved in the more-favored environments. More emphasis is needed now in the less favored environments. The main interventions in food-insecure areas should entail investing in water harvesting and developing drought-resistant crops.

Despite surpluses in the highlands, food security problems in Ethiopia are aggravated by the lack of purchasing power in the food-insecure lowlands and poor infrastructure that greatly raises the cost of food distribution from food-surplus to food-deficit areas.

Ethiopia has decentralized its training to the different administrative regions of the country, which, in turn, has greatly expanded the number of staff. An extensive training program has been developed. What has been learned is that different approaches are needed for the different regions. Training was done at both middle (training the trainers) and lower level (actual farmers).

The Ethiopian experience shows that subsistence farming offers little benefit for the future. Rather, developing and introduc-

ing improved technology, with the requisite human and institutional capacity building, should be the priority for government.

Good Practices: Uganda

Wilberforce Kisamba-Mugerwa (Minister of Agriculture, Animal Industries and Fisheries, Uganda) described Uganda as predominantly an agricultural economy. The minister pointed out that Uganda has implemented development paradigms that have helped to spur growth in the agricultural sector. These include:

- economic transformation, which began with modernization in agriculture
- concurrent development of industries that build on demand and supply links to agriculture
- participation of the poor in economic growth and development
- addressing nonmaterial aspects of poverty (insecurity, illness, isolation, and other hindrances)
- internal structural adjustment reforms
- the Poverty Eradication Action Plan

The minister emphasized that Uganda would have not been able to achieve the present level of agricultural growth if it had not planned a shift from subsistence farming to one based on science and technology. Rural education has been a priority in Uganda. It has been complemented by agricultural advisory services, which have brought about a high performance in extension services. National targets are to decrease subsistence farmers to 40 percent from 82 percent within 25 years and increase the contribution of commercial farming to the agricultural sector to 20 percent from 4 percent.

Building Partnerships: World Bank

David Nielson (World Bank) highlighted the many development goals shared by the World Bank and NEPAD. The United Nations millennium development goal is to halve the proportion of people whose income is less than US$1 a day and to halve the proportion of people who suffer from hunger by 2015. To achieve this goal the World Bank has set itself the following mandate: to work with governments to achieve a sustainable reduction in poverty, promote growth, and improve the quality of people's lives in developing countries.

The bank will achieve this mandate through funding development initiatives. The World Bank's funding support is primarily at national level and is based on poverty-reduction strategy papers (PRSPs). PRSPs must follow six principles: be country-driven, result-oriented, comprehensive, prioritized, long-term in perspective, and partnership-oriented. Thus at the political level, NEPAD should advocate stronger agricultural focus in the PRSPs. At the technical level, it must help ministries of agriculture engage actively in formulating PRSPs and hosting discussions on how PRSPs should deal with agricultural issues.

Building Partnerships: Japan

Katsumi Hirano (Institute of Developing Economies) pointed out that Japanese official development assistance (ODA) used to be oriented fundamentally to economic infrastructure, with assistance to Asia accounting for 60 percent of its total expenditure of US$10 billion. Since 1999, however, Japan has arisen from being a regional donor to the world's largest bilateral donor. In African development, Japanese ODA is carried out with few preconceived ideas, although there is a growing interest in *green* innovations.

Economic growth (preferably achieving two-digit GDP growth) and an increase in food production are crucial for Africa. Agricultural development is, therefore, seen as the basis for rapid economic growth. As part of the strategy, Japanese ODA also proposes introducing improved cereal

varieties as well as "South-South" cooperation particularly with Africa.

Research and Technology Dissemination

The topic of research, extension and technology transfer was principally assigned to Working Group 1, chaired by Florence Wambugu (A Harvest Biotechnology Foundation International), with Edwin Ijeoma (NEPAD) serving as rapporteur. Three speakers made presentations—Monty Jones (FARA) on strategies in agricultural research, by Kwesi Atta-Krah (IPGRI) on genetic diversity, and by Abu Michael Foster (SG 2000) on best practices in extension—followed by group discussions and recommendations. However, other working groups also discussed the topic and made recommendations. Thus, the final set of recommendations constitutes a collation of recommendations on these themes.

Strategies in Agricultural Research

The paper gave a background on agricultural research in Africa and suggested institutional reforms to enhance organization efficiency and effectiveness. Agricultural research in Africa is at present underfunded. Yet the technology challenges are formidable, given Africa's complex cropping systems, diverse climates, and varied pest problems. Mr. Jones suggested an approach for funding, involving competitive grants, to reduce duplication. The Forum for Agricultural Research in Africa (FARA) envisages increasing agricultural productivity by 6 percent per year over the next 20 years. FARA has a key role to play in working with NEPAD to harmonize and facilitate the efforts of agricultural research institutions in Africa.

Genetic Diversity

Diversity within plant genetics resources influences the sustainability and stability of agriculture and the environment. It is commonly accepted that genetic erosion is occurring at an alarming rate on the continent; something must be done urgently to stop or reduce it.

Genetic resources are vital to research and development in agriculture, while genetic diversity is important to food security. Many nutritious crops have gone out of use in Africa; bringing them back into diets could improve the health of the African people.

An international policy framework has been established at local, regional, and international levels to facilitate access, ownership, and benefit sharing in relation to plant genetic resources for food and agriculture. There is a need to harmonize approaches to implementing international agreements and other national and regional priorities.

Advances in plant biotechnology are moving at a rapid pace. These advances include crops that are classified as genetically modified organisms. Many countries in other regions are rapidly adopting these new varieties, making their production systems more efficient and reducing their costs of production. Sub-Saharan Africa is losing a competitive edge in commercial crops such as cotton and coffee as the debate on genetically modified organisms rages. Governments should institute a fast-track mechanism to assess and adopt these innovations and avoid losing the market share and efficiencies.

Extension Practices

Publicly funded extension systems in Africa continue take a variety of forms. But the trend is away from unified national systems to decentralized systems, using a plurality of different approaches, including contracting services to farmers, NGOs, private advisory services, and farmers' associations. Political, administrative, civil service, and macroeconomic reforms have

led to functional changes in ministries of agriculture and local governments, with the former concerned with planning, coordination, and technical backstopping and the latter with program implementation. Development of networks to share good practices is important.

Soil Fertility and Water Resources

The Ethiopian Vice Minister of Agriculture, Ato Belay Ejigu, chaired Working Group 2 on sustainable soil fertility and water resource development. Harry Quainoo served as rapporteur. Most recommendations came from this group, although participants in other sessions also made useful contributions. Background papers were presented by Fred Owino (African Academy of Sciences) on the role of forests in land management, by Amit Roy (IFDC) on soil fertility strategies, and by Marco Quinones (SG 2000) on smallholder water resources.

Sustainable Soil Fertility

African soils, formed from old weathered rocks, are naturally low in soil fertility. Traditional systems of shifting cultivation (slash and burn) have broken down due to increasing population pressures that have shortened fallow periods and accelerated nutrient mining by farmers. Reversing soil

RECOMMENDATIONS

Research and Technology Dissemination

1. NEPAD should establish mutual working relationships with relevant institutions including the Forum for Agricultural Research in Africa, with clearly spelled out roles and functions.
2. NEPAD should facilitate the formulation of sound agricultural development policies. Urgently needed are policies on biotechnology, biosafety, intellectual property rights, and biodiversity.
3. NEPAD should promote an agricultural system that is politically agreeable to NEPAD heads of state, adequately funded, scientifically and technologically competent, well coordinated with other high performing institutions, and focused on farmers and consumers. It should employ a bottom-up approach and promote best practices that work on the African continent and in similar situations elsewhere.
4. NEPAD should promote effective information and communications technology that supports training, networking, and disseminating research findings to farmers and other stakeholders who need such information.
5. NEPAD should promote public-private partnerships and encourage technology transfer across sectors and an acknowledgement and sharing of indigenous knowledge.
6. NEPAD should promote continuous monitoring and evaluation of on-going activities to facilitate adopting any new information, technologies, or inventions, such as the Nerica varieties, which promise a revolution in rice productivity.
7. NEPAD should encourage farmers to participate in programs that empower them to control the marketing of their own produce, such as one-stop centers that they own themselves.

degradation is central to modernizing agriculture in Africa. A holistic approach is needed to improve soil fertility and increase food production. Such an approach would include improved forest management, integrated organic and inorganic soil-nutrient replenishment strategies, and greater soil and water conservation measures.

The use of chemical fertilizer (in addition to organic fertilizer) would significantly improve the nutrient situation in Africa. Good lessons may be learned from Asian nations such as India, Pakistan, and China where intensification in the use of chemical fertilizer and modern varieties (along with irrigation) has transformed their agricultural sectors. In contrast to the Asian experience, fertilizer use in sub-Saharan Africa is grossly inadequate, resulting in widespread nutrient mining and food shortages.

Inorganic (chemical fertilizers) are very expensive in sub-Saharan Africa, though prices in the world market are the lowest in 30 years. Inefficiencies in the procurement-distribution-supply chain contribute to the high cost of fertilizer in sub-Saharan Africa. Most national fertilizer markets are fragmented and do not attract enough dealers and traders, leading to noncompetitive markets. A significant impediment for dealers and traders is lack of operating credit. Interest rates in many countries are relatively high and sometimes exceed 40 percent. Shortage of foreign exchange also remains a problem because almost all fertilizers are imported.

With relatively low livestock (cattle, swine, poultry) numbers, organic manures are generally not available in sufficient quantities in sub-Saharan Africa—or are too labor-intensive to collect and apply. Green manure crops often require that the land be kept out of crop production for a season, which is difficult for smallholders to manage. Some recent developments in agroforestry (improved fallows) suggest leguminous tree crops with nitrogen-fixing capacities could supply substantial quantities of soil nitrogen.

Integrated soil fertility management strategies that combine inorganic and organic fertilizers appear to be the most desirable options. They can lower the expense of purchased inputs and help build up organic matter, which is important to the long-term sustainability of African farmlands. In acidic soils, lime and gypsum are needed to correct low pH values.

Considerable soil fertility research has been carried out in sub-Saharan Africa, and various technologies and good practices are available in every country. What is needed is to catalog the repositories of information for different agroecological zones and categories of farmers, and to disseminate the resulting recommendations more effectively to farmers.

Water Resource Development

Africa has vast, varied, and unutilized fresh water resources. Reliance on irregular rainfall is a major constraint on crop productivity and prevents high-yielding varieties of crops from achieving their full production potential. Climatic changes increase risks and vulnerability of the agricultural sector, with serious implications for food security targets.

Currently, less than 5 percent of the cultivated area is under irrigation. Unfortunately, due to physical and economic constraints, the cost of developing large-scale irrigation is high and may not be economic, at least in the near term. Thus, large-scale irrigation must be seen as a longer-term development strategy.

In the near and intermediate term, sub-Saharan Africa's best option is to develop small-scale irrigation systems that use shallow aquifers, rivers, and streams. Such systems do not require resettling people, infrastructure needs are relatively modest, and the technology is simple. Farmers are

RECOMMENDATIONS

Soil Fertility

1. NEPAD should encourage governments to develop national soil fertility restoration and maintenance plans that are integrated with general issues of soil and water conservation, as well as protection and sustainable management of forest resources.
2. NEPAD should work with governments to address the high cost of fertilizer importation within the overall context of the macroeconomic situation of their countries. Priority access to foreign exchange for the traders should also be considered. Involve the private sector. Governments should be facilitators.
3. The types of fertilizer being imported need review. Bulk purchases and bagging at the end port can also permit the blending of different types of fertilizer. Instead of importing one fertilizer that contains all the nutrients required, it is cheaper to import three different fertilizers and mix them. Whether purchasing high concentration products would reduce unit costs of nutrients should be investigated.
4. To reduce the cost of chemical fertilizers in sub-Saharan Africa, NEPAD should work with governments to achieve greater regional integration of fertilizer supply through regional and subregional organizations. The Economic Community of West African States and West African Economic and Monetary Union should work with member countries to harmonize trade regulations, tariffs, quality, grades, and analytical methods. Similar approaches can be initiated by Southern African Development Community, Intergovernmental Authority on Drought and Development, and other regional bodies. Also competition among dealers at country-level should be introduced.
5. Efficient and effective management information systems are needed along with subsequent dissemination through mass media. Timely availability of information is vital for decision-making by entrepreneurs including farmers. Capacity building of research and extension on soil fertility needs and strategies is also needed.

able to participate actively in project design and management, and these small-scale irrigation systems can generate high and timely cash returns to smallholder farmers. Moreover, financial institutions willingly fund such small projects.

Small-scale irrigation systems can pave the way for crop-livestock value-added diversification systems.

Rural Infrastructure and Market Access

Developing rural infrastructure and enhancing market access was addressed by Working Group 3, which had two co-chairs: Isaac Aluko-Olokun and Abdou Aziz Sow of NEPAD. Maikel Lieuw Kie Song (University of the Witwatersrand) served as rapporteur. Background papers were presented by F. Taylor Parkins (University of the Witwatersrand) on employment-intensive construction of rural infrastructure, by Lars Wiersholm (HydroChem) on input delivery systems, by M. Evans (Booker Tate, Ltd.) on the Mumias experience, and by J. Magnay (Uganda Grade Traders, Ltd.) on Ugandan grain traders.

RECOMMENDATIONS

Water Resources

1. Rainfed agriculture should be progressively transformed into small-scale irrigated agricultural systems that utilize:
   - shallow rivers, ponds, streams, lakes
   - underground shallow aquifers (up to 30 meters deep) that are naturally recharged
   - water-harvesting techniques to capture and store rainwater
   - drip irrigation methods, which are more efficient
2. Small-scale irrigation systems can be financed by private banks because they are low cost. However, higher-valued production, such as fruits and vegetables and cash crops for export, is needed to justify these investments.
3. Water use and soil fertility strategies (resource management) should be developed in an integrated manner.

Developing Rural Infrastructure

Efforts to modernize African agriculture have been stymied by the highest marketing costs in the world. Efficient transport is the life-blood of economic modernization. It is essential for improving agricultural productivity and to enable farmers to bring their products to markets. Intensive agricultural production is especially dependent upon access to vehicles at affordable prices and passable roads. Unfortunately, most agricultural production in Africa still is generated along a vast network of footpaths, tracts, and community roads, where the most common mode of transport is the legs, heads, and backs of women. Indeed, the largest part of a household's time expenditure is for domestic transport. This situation places farmers in a double cost-price squeeze—between high farm-gate costs for inputs and low farm-gate prices for output.

Of the estimated US$89 billion required to improve rural infrastructure by 2015, 70 percent is allocated for roads, and an additional US$31 billion will be required over this period for maintenance of existing road systems. Employment-intensive construction and maintenance of rural infrastructure is worthy of consideration in an environment where more than 42 percent of the population lives on less that US$1 a day. Labor-intensive construction methods have proved to work in countries like Kenya, Ghana, Malawi, Lesotho, and Botswana. They can competitively provide this needed infrastructure by utilizing the abundant labor available in most African countries. In addition to quality infrastructure, the use of labor-intensive construction can provide increased employment, without increasing spending, by replacing equipment with labor.

Best practices from labor-intensive construction programs should be used to properly plan and implement employment-intensive construction programs in support of agriculture strategies.

The impact of HIV/AIDS on labor supply and capacity building need to be recognized in planning and implementing agricultural and rural infrastructure policies.

The financing of rural infrastructure remains a challenge. Governments, the private sector, and development partners should recognize the size of this challenge and devise innovative ways of financing

rural infrastructure. Because resources are scarce and investment trade-offs need to be made, governments should look at needs of small farmers as well as those of the agro-processing and export industry. Investments should be designed to meet local demand so that these transport systems are used effectively and the benefits they create will justify maintenance spending.

Bad government policies and corruption have impeded the development and maintenance of rural infrastructure and harmed agricultural production and trade. Good governance is an essential prerequisite for raising incomes of small farmers.

Specific government roles would be to ensure that when investments in rural infrastructure are made local labor is used effectively and to its potential. An important element is encouraging stronger local government and local institutions that can manage the construction and maintenance of rural (local) infrastructure. As is always the case with infrastructure, governments need to take a long-term perspective and avoid quick or ad hoc solutions.

Enhancing Market Access

Although the absolute price of production inputs (fertilizers, improved seeds, etc.) is significant in determining what a smallholder farmer can afford, it is the relative prices of inputs and outputs that really determine the profitability of input use. In sub-Saharan Africa, farm-gate fertilizer prices typically are two to four times higher than those found elsewhere. While higher input prices are inevitable in Africa in the near term—because of poor transport infrastructure and relatively low trade volumes—much can be done to reduce costs by correcting the market failures along the supply chain from the port of entry through farm delivery.

Global markets for agricultural products are not free, hence the issue of access to international markets needs to be explored within that context. The global cotton market, for example, is heavily distorted by U.S. subsidies, while the sugar market suffers from large interventions by the European Union. In terms of coffee, developing country producers need to cooperate instead of undermining each other with over-competitive pricing.

Access to international markets is important, but the potential for growing food crops as cash crops should also be emphasized. It is important for farmers to have a decent income from their efforts. As long as farming does not pay, farmers will have no incentive to increase their production and will not invest in fertilizers, improved seeds, or other inputs.

Furthermore small farmers need to be empowered so that they can make decisions that are in their best interests. Organizing small farmers into cooperatives and associations will provide them with a voice to lobby and negotiate.

Mumias Sugar Outgrowers. The Mumias sugar grower program in Kenya is a successful smallholder project that has been operating for more than 30 years. This program is based on collaboration between small-scale farmers who supply the sugarcane and the private sugar-processing industry, which serves the local sugar market. Over 50,000 growers participate, and sugar production has grown steadily to 250,000 tonnes per year. The project has led to increased commercialization by farmers. They are expanding the area of land devoted to growing sugarcane, preferring to buy food for family consumption on local markets. Farmers have also become shareholders in the sugar-processing industry itself. Major challenges faced by Mumias today are decreasing plot sizes and the rapid opening of the Kenyan sugar market to uncontrolled imports, leading to reduced income for farmers.

Uganda Grain Trade. Uganda Grain Traders, Ltd. (UGT) was established in 2001 in response to a huge harvest of maize in Uganda and Kenya. The oversupply led to a collapse of the maize price in this region. Meanwhile in southern Africa, a poor harvest caused shortages of maize. UGT was set up to attempt to export maize to the southern African market, and it was successful in exporting to Zambia. The Ugandan government supported UGT through a loan guarantee and providing storage facilities, but it did not provide finances. The government support made the swift response of the UGT possible. UGT has identified a viable market for grains and pulses in the region and sees great potential for Ugandan farmers to supply this market. It is encouraging small farmers to increase production by guaranteeing a minimum price for maize and pulses. Through collaboration between government and the private sector, a national crisis was turned into a new opportunity.

Price Stability. Prices of agricultural products need to be stabilized so that small farmers are not overexposed to the risk associated with wide swings in price during the year. Price stability can be achieved by governments working with the private sector as well as all relevant stakeholders. Grain pricing in Africa is complicated, and the cost of transport is one of the main factors determining price differentials. Government creates the business environment to encourage private investment in increasing production and marketing and also provides the broader strategic framework for managing international trade and food security. Possible specific government roles can be offering loan guarantees for initiatives that stabilize prices, serving as buyers of excess product at minimum prices to be used for strategic reserves, and protecting domestic or regional markets from unfair competition.

Regional Trade. Regional market access should be enhanced by encouraging regional inter-African trade. Governments need to facilitate better understanding and communication of trading opportunities in agricultural products within the continent. Trade in agricultural products with developed countries has been emphasized, but for many products this is impractical because of complicated subsidies and trade barriers. African leaders can control inter-African trade policies. Liberalizing these policies will increase trade and regional food security. Possible specific government roles could be liberalizing inter-African trade in agricultural products, establishing preferences for African products over developed-country products in government procurement, facilitating communication between countries so that market conditions are better understood across borders, and conducting research on the potential for regional trade in agricultural products.

For most countries, access to regional markets is poor, but the potential is highly significant from both an economic and a continental food security perspective.

Commodity markets, pricing, transparency, information on regional trade, and many other issues can be closely coordinated and enforced by regional economic communities. The issue of good governance and transparency should be monitored by the regional economic communities, together with all member states.

Food Security

Working Group 4 addressed the themes of food security and HIV/AIDS impact on agriculture. Wilberforce Kisamba-Mugerwa, Uganda's Minister of Agriculture, Animal Industries, and Fisheries chaired the group. The rapporteur was Musa Mdluli (Development Bank of South Africa). Background papers were presented by Richard Mkandawire (NEPAD) on sustainable

RECOMMENDATIONS

Rural Infrastructure and Market Access

1. African countries should not be wary of free international trade. Rather, governments should reserve the right to support domestic prices, provided that they reflect the true production costs of efficient producers.
2. Price stability and greater income security are essential to empower and encourage smallholder farmers to invest in increasing agricultural production.
3. The small farmer should be encouraged to form associations and cooperatives to be better able to cope with the risks of volatility of international commodity prices.
4. There are local and regional markets that need to be served, but they are often neglected. Ironically these markets are served by the United States and the European Union. African countries should seek to exploit African markets as well as the wider international markets.
5. Markets are information-driven, and improved access to local prices as well as futures pricing for African agricultural markets are necessary to enhance regional trade.
6. There is a need for capacity building to deal with international trade and market-access negotiations.

agriculture, food security, and poverty reduction and by Joseph Tumushabe (Makerere University) on HIV/AIDS mitigation in agricultural development programs.

It is estimated that about one-third of sub-Saharan Africa's population is chronically hungry. Moreover, during the 1990s, the absolute number increased from 173 to 200 million people. Roughly two-thirds of those receiving assistance from the World Food Program live in Africa. In 2001, estimates of the number of people suffering from food emergencies in sub-Saharan Africa ranged from 23 to 28 million.

Africa's food insecurity is the result of a confluence of factors over time. Droughts and flooding are often the major causes. However, in some countries, notably Somalia and Zimbabwe, the crisis has been aggravated by civil conflicts and government policies.

By definition, food security is not simply about availability of food. It also entails the ability of individuals—or a nation—to access food on a sustainable basis. In addressing sub-Saharan Africa's food insecurity, it is critical that government and other stakeholders take a holistic view, not only in addressing the causes, but also in exploring interventions that will overcome them. Given the enormity of the food crisis in sub-Saharan Africa, countries need to give priority to areas that will be able to yield the highest social returns among food-deficit households.

Because many of Africa's food-insecure are rural dwellers engaged in some form of agriculture, priority must be given to increasing agricultural production among food-insecure households. Various interventions are needed, such as increased use of fertilizers, improvements in mixed-cropping systems, livestock rearing, and agroforestry practices.

Paralleling the decline in agricultural research investments in sub-Saharan Africa has been a decline in the generation of

improved technologies for smallholder farmers. Not surprisingly, extension systems and extension workers, like most public servants, have become increasingly alienated from farmers. This situation needs to be reversed. Additional financial resources will be required. Reorientation in research and extension paradigms is also critical.

Agricultural research and extension systems will need to pay greater attention to traditional production systems of food-insecure farmers in the design of improved technologies. While external inputs may be appropriate, greater use of locally available resources is also essential, given resource endowments and risk profiles. Consideration of the needs of women farmers is especially important.

Sub-Saharan Africa has a larger proportion of young people in its population than any other region of the world. In most countries of sub-Saharan Africa, people under 25 years old constitute more than two-thirds of the population. Those between 15 and 25 years of age constitute about 30 percent of the population. As the result of high and growing incidence of poverty, which frequently is an adverse outcome of economic restructuring, large numbers of young people have been marginalized from education, health care, and salaried jobs. Marginalized young people are, in effect, the "arsenals" that keep the wars of Africa raging. Countervailing strategies are needed to offset this trend. More opportunities for youth enterprise promotion, both on and off the farm, are needed.

The minimum price for agricultural products, the import parity price, and the regional food supply are all significant considerations in formulating food security policies and building strategic stocks and reserves.

Early warning systems, integrated with national and regional strategic reserves, are needed to deal with catastrophic drops in domestic food production, either due to natural calamities or civil strife. Governments should establish strategic grain reserves by purchasing grain from surplus-producing areas. These purchases will help stabilize the producer's price and prevent sudden price collapses. Strategic grain reserves can also protect the country from unexpected loss of production during drought years.

Safety-net programs are needed for chronically vulnerable groups. Examples are food stamp programs, school lunch programs, and food for work programs. Best practices should be identified.

Individually, small farmers are unable to mobilize resources to influence the market. There is therefore a need for them to organize into lobbying groups to improve the terms on which they access markets for inputs and outputs, technology generation, and finance, and to influence trade and tax-related policies and programs.

Impact of HIV/AIDS on African Agriculture

It is estimated that nearly 30 million adults and children in Africa are living with HIV/AIDS and that 2.2 million died of AIDS in 2001. Between 2000 and 2020, some 55 million Africans will have their lives terminated prematurely due to AIDS. The negative impact is especially serious in southern and eastern Africa, where HIV infection rates often run between 20 and 30 percent of the sexually active population. The consequences on household, community, and national agriculture productivity and sustainable development are varied and threaten any meaningful development approaches.

For NEPAD the challenge of the HIV/AIDS pandemic is to prevent further spread of HIV/AIDS and to identify and effect strategies that will improve the economic capacities of households affected by HIV/AIDS.

RECOMMENDATIONS

Food Security

1. NEPAD should work with governments to build a stronger agriculture and rural development presence in national and donor development plans, and especially poverty-reduction strategy programs being developed by the World Bank.
2. NEPAD should lobby to increase financial support for an African research system capable of generating technology for a significant range of farmers.
3. NEPAD should support efforts to inventory and share technology more effectively among African countries.
4. NEPAD should find funding to empower farmers' organizations and civil societies to build themselves internally and as networks.
5. To reach farmers with agricultural and business advisory services, NEPAD should publicize innovative approaches, including NGOs and private suppliers.
6. NEPAD should work with governments to build national and regional famine early warning systems.
7. NEPAD should work with governments to identify best practices in safety-net programs involving food distribution to vulnerable families.

In the medium and long term, HIV/AIDS-affected households and communities, like other production groups, can and should be empowered to take care of their food and development needs, rather than remaining candidates for relief and pity or being sidelined on the development path.

African farmers possess limited numbers of tractors. Even animal draught power is limited. Most of the energy that goes to agriculture production comes from the human muscle. With the HIV/AIDS pandemic ravaging Africa, the human labor in agriculture has become crucial.

Use of Bt/Round-Up Ready/high quality protein maize varieties in combination with minimum tillage practices, can permit the farmers to expand the land under cultivation, while minimizing drudgery of weeding and pest control, protecting soils from

RECOMMENDATIONS

HIV/AIDS and Agriculture

1. NEPAD should encourage government and other leaders to appreciate HIV/AIDS as a major health problem that needs the highest level of attention and investment in mitigation and prevention.
2. NEPAD should encourage governments to develop culture-specific messages on prevention, mitigation, and minimizing stigma, as well mechanisms for delivering messages.
3. NEPAD should work with governments to re-train extension staff to understand the needs of HIV/AIDS-affected households and to respond effectively by promoting laborsaving technology and crops that can improve nutrition.

erosion, and producing a crop with high nutritional value.

Closing Session

The session was opened by Nicéphore D. Soglo (former president of Benin) who expressed satisfaction with the success of the workshop. He encouraged both NEPAD and SAA to work hard toward fruitful follow-up from the workshop and thus help make agriculture the engine of sustainable economic growth and development that it must become on the African continent.

Mr. Soglo urged participants to look into the best agricultural practices that have been developed in parts of Asia and Latin America, which have recorded some successes in agricultural research and development, to see how these may apply to African agriculture. He urged the African leaders to keep up the good work they have started in NEPAD by putting into motion a dynamic agricultural initiative for the continent.

Jean Freymond (CASIN) thanked the participants for their efforts and hard work. He remarked that he hoped that this event marked the beginning of a long-lasting relationship between NEPAD and the SG 2000 program.

Wiseman Nkuhlu (NEPAD) thanked the organizers for bringing such a high caliber of people to participate in the workshop, and for their contributions to helping African countries, individually and collectively, in their efforts to achieve sustainable economic growth. He went further to say that NEPAD is poised to champion the cause of agriculture in Africa by making sure that it takes its rightful position in the political development agenda.

Prof. Nkuhlu told participants that, while there is a need to move expeditiously with the recommendations of this workshop, NEPAD would need to sieve them and integrate the sound ones into the NEPAD agricultural agenda. There is also a need to consider the mandate of African leaders to NEPAD before recommending initiatives be developed to a mass scale.

Food Security and Agricultural Development in Sub-Saharan Africa: The Challenges Ahead

Norman E. Borlaug and Christopher Dowswell

Without doubt, improved productivity in agriculture is central to the goals of reducing poverty and stimulating economic growth. In the absence of such improvements, it is hard to see how any of the United Nations millennium goals will be reached for Africa.

Over the past 40 years, global food production has more than kept pace with population growth. Worldwide cereal supply was 23 percent greater per person in 2001 than in 1961, and real prices for cereals were 60 percent lower. Nevertheless there is no room for complacency. With each generation, the challenges of sufficient and equitable food production become more daunting.

By 2020, not only will we have to reproduce the current annual harvest in its entirety, but also expand it by at least 50 percent. This target cannot be reached unless farmers across the globe have access to currently available high-yielding crop production technology as well as to the new biotechnological breakthroughs, which offer great promise for improving the yield potential, yield dependability, and nutritional quality of food crops, as well as improving human health in general.

Africa: A Sleeping Agricultural Giant

Sub-Saharan Africa produced about 372 million gross tonnes of food of all types during 2000–01 (table 1). Converted to edible dry matter, this amounts to about 154 million tonnes. This output represents about 6 percent of the world food supply, even though the nations south of the Sahara account for roughly 11 percent of world population.

The composition of sub-Saharan Africa's food supply diverges somewhat from world food supply statistics. Cereals account for about 50 percent of the African diet, compared with 70 percent at the global level. In contrast, roots and tubers account for 28 percent of the sub-Saharan Africa food supply, compared with only 7 percent globally. Finally, fruits are more important to the sub-Saharan Africa diet (4% versus 2%), and animal products, including fish, are less important (5% versus 8%), when compared with global food supply statistics.

At present, food import trends in sub-Saharan Africa are worrisome (table 2). While many argue that basic food self-sufficiency should not be a national goal, we do not wholly agree. Where sub-Saharan Africa has the ecological conditions to expand production—and where improved technology is available—we believe that national policies should be geared toward meeting demand through domestic production. Wheat is a major exception because the ecological conditions to produce it competi-

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Table 1. Food supply in sub-Saharan Africa (including South Africa), 2000–01 (million tonnes).

Commodity	Gross volume	Edible dry matter[a]	Protein[a]
Cereals	88.8	77.9	7.8
Maize	37.4	33.0	3.6
Sorghum	18.4	16.6	1.6
Millet	13.2	11.9	1.1
Rice	11.2	7.6	0.6
Wheat	4.9	4.3	0.5
Other	3.7	3.4	0.3
Roots and tubers	160.0	42.6	2.8
Legumes, oilseeds/nuts	15.0	10.2	3.6
Sugarcane and sugarbeets[b]	7.6	7.6	0
Vegetables and melons	21.5	2.3	0.2
Fruits	46.2	6.3	0.3
Animal products	33.1	7.5	3.4
Milk, meat, eggs	28.2	6.3	2.5
Fish	4.9	1.2	0.9
All food	372.2	154.4	18.1

a/ At zero moisture content, excluding inedible hulls and shells.
b/ Sugar content only.
Source: Faostat.

tively do not exist, except in a few countries. Over the past 25 to 30 years, the demand for wheat grain and flour has expanded greatly (aided by U.S. PL480 policies that make wheat grain and flour available at concessionary prices). Imports now amount to nearly US$2 billion per year.

But for most other crops, such as rice, sugar, maize, fruits, and vegetables, sub-Saharan Africa should strive to develop its domestic production capacity. Domestic production gives employment to farmers and saves scarce foreign exchange for other purposes.

With vast untapped land areas, lots of sunlight, and large numbers of days per year when crops can be grown—sub-Saharan Africa has enormous agricultural development potential. In fact, theoretical estimates of potential productivity place Africa second among the continents, behind Latin America but ahead of Asia, Europe, North America, and Australia (Plucknett 1992). To achieve this potential, however, African agriculture and rural economies need to be accorded much greater investment priority than they currently are in national economic development plans and strategies.

We have yet to see the full toll that HIV/AIDS and other diseases will take on population growth in sub-Saharan Africa. To date, the United Nations Population Fund has continued to project rapid population growth in Africa (table 3). By 2050, Africa (including North Africa) is projected to surpass China and East Asian countries in population, with more than half being urban residents. These are huge demographic changes, with far-reaching implications for agriculture. Much more extensive—and efficient—rural transport systems will needed. The food chain will have to be

Table 2. Major food imports in sub-Saharan Africa (million tonnes).

Commodity	1998	1999	2000
Wheat + flour, equiv.	8.4	7.3	9.3
Rice	4.1	4.2	4.0
Sugar, refined	2.1	2.1	1.9
Maize	2.4	1.6	1.4
Fruits and vegetables	1.0	1.1	1.2
Processed oils	0.2	0.1	0.1
Pulses	0.2	0.2	0.3

Source: Faostat.

Table 3. Population projections to 2050.

Region	Total population (millions)			Urban (%)	
	2001	2030	2050	2001	2030
Africa	813	1,489	2,000	38	54
South Asia	1,435	1,974	2,417	31	46
West Asia	264	457	545	65	70
Southeast Asia	530	825	800	37	59
East Asia	1,492	1,698	1,655	39	54
Europe	726	670	603	75	83
Latin America & Caribbean	527	723	806	75	83
North America	317	396	438	77	84
Oceania	31	42	47	70	74
World	6,134	8,270	9,322	47	60

Sources: United Nations Population Fund 2001; Faostat.

significantly lengthened, with many new post-production activities, ranging from grain storage to processing and distribution.

The SG 2000 Agricultural Program

Currently, Sasakawa-Global 2000 is operating in 10 countries of sub-Saharan Africa, working with national extension and research services, selected other nongovernmental organizations, donors, and farmers to intensify agricultural production. Over the past 16 years, SG 2000 has helped several million small-scale farmers to establish crop demonstration plots—ranging in size from 0.1 to 0.5 ha—to evaluate improved technological packages for maize, sorghum, wheat, cassava, rice, and legumes. With few exceptions, participating farmers have obtained demonstration plot yields that are two to three times higher than the corresponding national averages.

Thousands of field days, attended by several million farmers, have been organized to demonstrate the yield potential and explain the components of the production packages. Despite high levels of enthusiasm by farmers and attending political leaders, adoption of the food crop technologies recommended by SG 2000 has not been as widespread as we would have hoped. In particular, owing to high costs, farmers have had difficulty adopting the fertilizer recommendations, which are so critical to productivity improvements. In addition, there has been considerable volatility in the market prices of the staple food crops because of weather and technology introductions.

Agriculture as an Engine of Economic Development

History should have taught us that no nation has been able substantially reduce poverty and bring about economic development without first markedly increasing the productivity of its agricultural and food systems. Over the past 40 years, agricultural growth in Africa has been highly uneven. Between 1960 and 1975, agricultural growth was 3 percent per year, more or less keeping pace with population growth. Then, between 1975 and 1985, African agriculture stagnated, increasing only 1.8 percent per year, which led to considerable hunger, malnutrition, and suffering. This alarming situation provoked increased attention to agriculture, both in the donor community and in national governments. As a result, since 1985, agriculture resumed growing at about 3 percent per year, roughly equal to population growth. Unfortunately, national priorities on agriculture in Africa and donor support began to diminish in the late 1990s, as evidenced by the World Bank agricultural loan portfolio, which declined by 78 percent between 1990 and 1999 (Wolgin 2001).

This trend of shrinking investments in agricultural development must be reversed. Most experts agree that African agriculture must grow 5 to 6 percent per year if it is to be a major force in reducing poverty. To attain such growth rates, important policy changes and significantly more investments will be needed. Four broad objectives must be pursued:

- increased productivity of domestic food crops
- greater shifts to high-value commodities
- development of an export sector
- expanded off-farm rural employment opportunities

Two serious underlying problems must be solved to achieve these development objectives. One is to reverse the growing environmental degradation associated with widespread soil nutrient mining. The other is to bring down marketing costs in Africa, which are the highest in the world.

Africa's Pervasive Soil Fertility Problem

Many tropical environments in Africa, especially in forest and transition areas, are fragile ecological systems, where, under continuous cultivation, deeply weathered soils rapidly lose fertility. In an earlier day, traditional systems of shifting cultivation and complex cropping patterns permitted low-yielding, but relatively stable, food production systems. However, expanding populations and food requirements shortened the bush-fallow periods previously used to restore soil fertility and forced farmers to cultivate increasingly marginal lands. With continuous cropping on the rise, organic material and nitrogen have been rapidly depleted from African soils, while phosphorus and other nutrient reserves are being depleted slowly but steadily. This fertility decline is having disastrous environmental consequences.

The magnitude of nutrient mining in sub-Saharan Africa is enormous. Sanchez et al. (1996) estimate that during the past 30 years the net per-hectare loss on about 100 million hectares of cultivated land is about 700 kilograms of nitrogen, 100 kilograms of phosphorus, and 450 kilograms of potassium. In contrast, over the same period, commercial farmers in North America and Europe have averaged net per-hectare nutrient gains of more than 3,250 kilograms of NPK on 400 million hectares.

While farmers should endeavor to use all of the organic nutrients that are economically feasible, not only to replenish nutrients but to improve overall soil structure and health as well, there simply are not enough organic manures and crop residues available to replenish and maintain soil fertility in the higher-yielding production systems needed to meet growing food requirements and reduce poverty. Thus, increased consumption of chemical fertilizer is essential in most smallholder agricultural systems, but especially in sub-Saharan Africa. At present only around 9 kilograms of nutrients per hectare are used for agriculture in sub-Saharan Africa—and only half this amount is used for growing food crops—compared with 10 to 20 times as much in most of developing Asia and the industrialized nations (table 4).

Only since World War II have inorganic fertilizer use, and especially the application of low-cost nitrogen derived from synthetic ammonia, become an indispensable component of modern agricultural production. Nearly 80 million tonnes of nitrogen are now consumed annually. Vaclav Smil of the University of Manitoba, who has studied nitrogen cycles for most of his professional life, estimates that 40 percent of world's 6 billion people are alive today thanks to the Haber-Bosch process of synthesizing ammonia (Smil 2000). It would be impossible for organic sources to replace this amount of nitrogen, no matter how hard we might try.

Table 4. Fertilizer nutrient consumption per hectare of arable land, 2000.

Country	Amt (kg/ha)
Uganda	1
Ghana	3
Guinea	4
Mozambique	4
Tanzania	6
Nigeria	7
Burkina Faso	9
Mali	11
Ethiopia	16
Malawi	16
Benin	18
Cuba	37
South Africa	51
India	103
United States	105
Brazil	140
France	225
China	279
United Kingdom	288
Japan	325
Vietnam	365
Netherlands	578

Source: Faostat.

It makes no biological difference to the plant whether the nitrate ion it "eats" comes from a bag of fertilizer or decomposing organic matter. Moreover, given the low current levels of fertilizer use, and the alarming decline in soil fertility in sub-Saharan Africa, a strong case can be made that increased fertilizer use is one of the most environmentally friendly things we can do. We need to shift the debate to how best to supply adequate plant nutrients in the most efficient way possible.

The SG 2000 field program has been grappling with this soil fertility problem for 16 years. Various strategies have been pursued, such as split applications and incorporation of fertilizers to maximize use efficiency; timely weeding; introducing green manures, grain legumes, and nitrogen-fixing shrubs and trees into rotations with cereals and roots and tubers; and building up organic matter in the soil profile through mulches. These sorts of integrated approaches can increase soil organic matter and improve soil fertility, while reducing the outlays needed for purchased fertilizers. However, we also must be realistic. Many of the so-called organic approaches may be too labor-intensive for farmers to apply widely to the main field crops. Thus, chemical fertilizers must be placed at the center of Africa's soil fertility restoration strategies.

Even if fertilizer use rates in sub-Saharan Africa were doubled or tripled over the next two decades, consumption per hectare of arable land would still lag far behind that of all other agricultural regions in the world. For fertilizer consumption to increase, the profitability of its use must be improved. There are only two ways this can happen. The best solution is to improve fertilizer supply systems. Because of unnecessary market failures all along the supply chain, farm-gate fertilizer prices in sub-Saharan Africa are two to four times higher than those found elsewhere. Although higher prices are inevitable in Africa in the near term—because of poor transport infrastructures and relatively low trade volumes—much can be done to reduce costs through improved policies and supply practices.

However, pervasive poverty may also require some form of targeted subsidies as well. We recognize the danger of subsidies, in that they are costly and the allocation process becomes politically driven, rather than market driven. Yet, market liberalization efforts thus far have failed in sub-Saharan Africa. Fertilizer consumption was roughly the same in 2000 as it was in 1985. Unless sub-Saharan Africa's current dysfunctional and fragmented fertilizer supply systems can be righted, some sort of public intervention must be considered. Africa's soils, and its impoverished food-insecure farmers, cannot wait forever for the market mechanism to work.

Overcoming the Infrastructure Bottleneck

Efforts to modernize African agriculture have been stymied by the highest marketing costs in the world. Africa has the fewest kilometers of paved roads per capita in the world (table 5). Uganda only has 94 km per million people, Ethiopia 66 km, Mozambique 141 km, compared with 1,064 km in Brazil, 1,586 km in Zimbabwe, 12,987 km in France, and 20,987 km United States.

To give an example close to home, for a total of US$45 to $48, a tonne of maize can be shipped from a U.S. farm to Mombassa, 11,000 kilometers away, with $21 to $22 going for transport from the farm to a U.S. gulf port and another $23 to $26 from the Gulf port to Mombassa. To transport the tonne from Mombassa to Mbarara—less than 1,500 km—it would cost $90 to $100/t to reach Kampala and probably another $35 to $40/t to reach Mbarara, for a total of $125 to $140, which is nearly three times the cost to ship a tonne of maize from a farm in the United States all the way to Mombassa—a distance seven times greater.

Efficient transport is the life-blood of economic modernization. It is essential to improve agricultural productivity and enable farmers to bring their products to markets. Intensive agricultural production is especially dependent upon access to vehicles at affordable prices. Unfortunately, most agricultural production in Africa still is generated along a vast network of footpaths, tracks, and community roads, where the most common mode of transport is the legs, heads, and backs of women. Indeed, the largest part of a household's time expenditure is for domestic transport. This situation places farmers in a double cost/price squeeze—between high farm-gate costs for inputs and low farm-gate prices for output.

Table 5. Length of paved roads per million people in selected countries.

Country	Roads (km)
United States	20,987
France	12,673
Japan	9,012
Zimbabwe	1,586
South Africa	1,402
Brazil	1,064
India	1,004
China	803
Guinea	637
Ghana	494
Nigeria	230
Mozambique	141
Tanzania	114
Uganda	94
Ethiopia	66

Source: Encyclopaedia Britannica 2002.

Finding ways to provide effective and efficient infrastructure (roads, potable water, and electricity) in sub-Saharan Africa underpins all other efforts to reduce poverty, improve health and education, and secure peace and prosperity. Not only will improved rural infrastructure increase agricultural productivity and spur economic development, it will reduce rural isolation, thus helping to break down ethnic animosities and allow rural schools and clinics to be established in areas where teachers and health care workers have heretofore been unwilling to venture.

Indeed, achieving universal primary education and improved primary health care should be viewed as essential agricultural development goals as well. A comparison of China and India—the world's two most populous countries—serves to make the point that increased food production, while necessary, is not sufficient to achieve food security. Over the past 20 to 30 years, both countries have achieved remarkable progress in food production. Huge stocks of grain have accumulated in India over the past several years, yet hundreds of millions need more food but do not have the purchasing power to buy it. Indeed, nearly half of India's children remain malnourished, compared with only 9 percent in China.

Why has China been more successful in

achieving broad-based economic growth and poverty reduction than India? Nobel Economics Laureate Amartya Sen attributes the difference to the greater priority that the Chinese government has given to investments in rural education and health care services, compared with India. With a healthier and better-educated rural population, China's economy has been able to grow about twice as fast as the Indian economy over the past two decades, and today China has a per capita income nearly twice that of India.

Enhancing Domestic Food Crops Productivity

Domestic food production is the most important agricultural activity in a nation. In Africa, as populations have grown, food production been increased by expanding the area under cultivation. Little progress has been made in increasing average yields in Africa, compared with Asia and Latin America. In Asia and Latin America, yield increases have been driving forces in production growth over the past 30 years. Expanded and more efficiently produced food supplies reduced real prices—the equivalent of increasing the real wages—and led to broad multiplier effects in manufacturing and other sectors of the economy. And by achieving higher yields on the lands best suited to agriculture, vast of forests and grasslands and many fragile environments were spared from coming under cultivation.

In charting a new agricultural development course for Africa, NEPAD officials must not to lose sight of some of the key lessons of the green revolution in Asia (table 6). One is the importance of combining improved germplasm (varieties) with increased fertilizer use. Too often green revolution observers focus on the wheat and rice varieties, as if they alone can produce miraculous results. Certainly, modern varieties can shift yield curves higher due to more efficient plant architecture and the incorporation of genetic sources of disease and insect resistance. However, these modern, disease-resistant varieties can only achieve significant productivity impacts if systematic changes are also made in crop management, such as in dates and rates of planting, fertilization, water management, and weed and pest control. Moreover, many of these crop management changes must be applied simultaneously if the genetic yield potential of modern varieties is to be fully realized. For example, higher soil fertility and greater moisture availability for growing food crops also improves the ecology for weed, pest, and disease development. Thus, complementary improvements in weed, disease, and insect control are required to achieve maximum benefits.

We, of course, recognize that there are also major differences between Asia and most of sub-Saharan Africa, especially with respect to irrigation. Only around 5 percent of agricultural lands in sub-Saharan Africa

Table 6. Changes in factors of production in developing countries of Asia.

	Adoption of modern varieties							
	Wheat area		Rice area		Irrigation	Fertilizer nutrient use	Tractors	Cereal production
Year	(million ha)	(%)	(million ha)	(%)	(million ha)	(million t)	(millions)	(million t)
1961	0	0	0	0	87	2	0.2	309
1970	14	20	15	20	106	10	0.5	463
1980	39	49	55	43	129	29	2.0	618
1990	60	70	85	65	158	54	3.4	858
2000	70	84	100	74	175	70	4.8	962

Sources: Faostat, July 2002, and authors' estimates on modern variety adoption, based on data of the International Maize and Wheat Improvement Center and the International Rice Research Institute.

are irrigated, with this confined mainly to two or three river valleys. In contrast, 175 million hectares are irrigated in the developing countries of Asia, which stretch from Turkey in the west to the Pacific Rim countries in the east.

Another important difference is access to traction power. Asia began the green revolution with buffalo and oxen, and then moved to mechanical power—from the ubiquitous two-wheel cultivators to four-wheel tractors and combines. Finally, Asia had a much better transport infrastructure in place and stronger research and extension organizations than is generally the case in sub-Saharan Africa.

Still, sub-Saharan Africa has a wealth of improved food crop varieties and crop management technologies that can double, triple, and even quadruple traditional yields. Earlier maturing, drought- and disease-resistant, high-yielding varieties of maize, rice, sorghum, cassava, and grain legumes offer exciting new possibilities for multiple cropping in the future, such as the introduction of green manure crops and improved fallows. Conservation tillage offers great hope for checking soil erosion, conserving moisture, building up organic matter, and reducing the backbreaking work and drudgery of hand weeding and land preparation.

Nutritionally superior maize, called quality protein maize (QPM), also is now being enthusiastically adopted by substantial numbers of farmers in a growing number of African countries. With its much higher levels of the essential amino acids lysine and tryptophan, QPM can do much to improve human and livestock diets in Africa. Maize is the major cereal crop in Africa—grown on 100,000 hectares or more in 24 nations. Maize also is a principal source of calories in typical diets, especially in southern Africa. More than 300,000 hectares of QPM are grown in sub-Saharan Africa, and this area is likely to double or even triple over the next 5 to 7 years.

African agricultural sector planners must take heed to not turn their backs on domestically produced crops. Africa cannot afford to import increasing quantities of its food supplies. Moreover, African nations should not want to do so. Domestic food production systems can be transformed. Basic self-sufficiency in all but a handful of crops (such as wheat) is achievable, and at prices competitive to those found in the international markets. Basic foods (cereals, roots and tubers, and grain legumes) are the heart of almost all national agricultural systems in the world. In the United States, maize and soybeans account for slightly more than 50 percent of the total crop area. Africa must not underinvest in primary food crops. To do so would be disastrous.

While the more-favored environments will be the areas most likely to produce the growing surpluses needed to feed an urban Africa, greater attention must also be placed on trying to introduce improved technology into the more marginal production areas, where large numbers of food-insecure people reside.

Over the long term, those engaged in low-output farming and pastoral activities will undoubtedly need to find employment in more productive agricultural areas or off the farm. But there are a number of interventions that can improve the current situation. Earlier-maturing and drought-tolerant higher-yielding varieties can help. Water harvesting and small-scale supplemental irrigation technologies can help. Sometimes, controlling a disease situation like downy mildew on millet and sorghum can help. While the scope for yield gains is more modest, we cannot turn our backs on these marginal areas.

In Ethiopia, surplus cereal production is being regularly produced in the well-watered highlands, yet millions are at risk of

starvation in the dry lowlands. We believe that international donors have a role to play in developing and funding social safety-net programs to assist chronically food-insecure and extremely resource-poor people. One excellent intervention would be school lunch programs to provide healthy meals free of charge throughout sub-Saharan Africa. Another might be food-for-work programs, which could buy up surplus production and redistribute it to food-short areas and people in exchange for labor on useful public works.

Expanding Value-Adding Agricultural Activities

Having argued strongly for strengthening domestic food production of traditional crops, it is also clear that smallholder farmers in sub-Saharan Africa need to engage in more value-adding activities such as expanding livestock production and food processing activities using primary crops produced on the farm as raw materials. Livestock is an especially neglected area. Increased production of domestic food staples creates surpluses that can be used as livestock feed, and thus converted into milk, eggs, and meat through expanded livestock production.

In addition, considerable opportunities to add value exist in food processing to make flours, sauces, condiments, and other processed foodstuffs for sale in local and even distant markets. This sort of small-scale food processing can often be done with relatively simple equipment, either on the farm or by village groups.

Given the rapid rates of urbanization, African nations need to give much greater attention to the commercial food chain—from the farmer to the consumer. Developing the commercial food chain is especially important because 25 to 30 years from now more Africans may be living in urban areas than in rural areas.

Creating Competitive Advantage in Exportable Crops

While overall demand for agricultural products in African countries will continue to come mostly from domestic markets, greater participation in international and regional markets will be crucial for future agricultural development. Some African nations will need to regain competitiveness in traditional export markets like coffee, bananas, palm oil, cocoa, and cotton. In fact, over the past 25 years, sub-Saharan Africa has lost market share in all of its traditional agricultural export markets except tea.

Africa will need to develop new entrepreneurial skills to find and expand market niches for a wide variety of nontraditional crops, as well. Improving the efficiency and cost-effectiveness of transport systems—surface, water, and air—will be critical for developing new competitive advantages. Crops with potential are likely to include various fruits, vegetables, spices, and flowers. There may also be niche markets in medicinal plants that could be developed. More could be done in agroforestry to develop commercial tree production, especially of selected exotic hardwoods. Such agricultural enterprises may not represent huge markets or sources of employment, but they nevertheless remain important because of the high value of the commodities and the dynamic nature of the markets.

We would caution, however, that many of these export-oriented industries—especially for fruits, vegetables, and livestock—have high marketing standards and requirements. Producing for supermarkets in OECD countries is not easy, and it is highly competitive. In addition, in the aftermath of the terrorist attacks in the United States on September 11, 2001, new bio-terrorism rules and regulations will place new nontrade barriers to entry for agricultural products. So while nations

should certainly strive to expand their export agriculture, it would be naïve to think that this can be achieved fairly easily.

Regional trade in agricultural products also has considerable potential. Here again, improved transport systems will be essential, and transport policies and systems will need regional coordination and investment among neighboring countries. An excellent example of the potential for regional trade can be illustrated by the border trade between Uganda and Kenya, which may equal 60 percent of total official agricultural exports (Wolgin 2001). However, higher official Kenyan import tariffs on maize leads to smuggling, with shipments broken up into head and bicycle loads, and often reassembled once across the border. This process adds to trading costs. If inter-country trade barriers are reduced, transaction costs will drop. Instead of trying to stop or stifle such regional trade, the governments of Uganda and Kenya should be working together because both benefit from more efficient production and trade between them, not only in maize but in other staples as well.

Developing Off-Farm Employment Activities

Getting agriculture to grow faster is the first important step in increasing rural incomes and expanding off-farm employment. However, agriculture alone cannot provide employment for all those who live in rural areas, especially over the longer term. Rural on-farm and off-farm employment must be expanded to prevent poverty and to slow migration to desperately poor urban slums.

Some of these off-farm activities are related to agriculture, such as production of inputs, packaging for agricultural products, and processing of agricultural output. Others are more distinct from agriculture like small-scale manufacturing and services, including hotels and restaurants, construction companies, garages and petrol stations, retail stores and markets, doctors and lawyers, etc.

Rural development and off-farm employment generation will not happen without the right policies and investments. In the past, many rural development programs failed because their management was too centralized, failing to seek input and participation from key stakeholders, and because they were too public-sector oriented, failing to recognize the key role that private-sector expertise and capital must play in infrastructure development.

If governments want to develop their rural economies, they must invest more in human resources, especially primary education, primary health care, and adult literacy. In addition, governments and private organizations will need to forge new investment partnerships to mobilize the necessary resources to develop national infrastructure, especially roads, water supply, electricity, and telecommunications. Governments will not be able to achieve this task going it alone.

What Can We Expect from Biotechnology?

In the last 20 years, biotechnology based upon recombinant DNA has developed invaluable new scientific methodologies and products in food and agriculture. This journey deep into the genome—to the molecular level—is the continuation of our progressive understanding of the workings of nature. So far, these gene alterations have conferred mainly producer-oriented benefits, such as resistance to pests, diseases, and herbicides. However, other benefits are likely to come through biotechnology and conventional plant breeding, such as developing crop varieties with greater tolerance of drought, waterlogging, and heat and cold. Those are important traits, given current predictions of climate change. In

addition, many consumer-oriented benefits, such as improved nutritional and other health-related characteristics, are likely to be realized over the next 10 to 20 years.

Beyond benefits that may be forthcoming to food, feed, and fiber production, biotechnology may lead to plants that could actually be used to vaccinate people against diseases such as hepatitis B virus or Norwalk disease (which causes diarrhea) simply by growing and eating them, which could offer tremendous benefits especially in poor countries. This line of research and development should be pursued aggressively and probably through public-private partnerships because traditional vaccination programs are costly and difficult to execute.

Despite the formidable opposition in certain circles to transgenic crops, their adoption by farmers has been one of the most rapid examples of technology diffusion in the history of agriculture. Between 1996 and 2001, the area planted commercially to transgenic crops increased from 1.7 million hectares to 52.4 million hectares (James 2002). Estimates for 2002 indicate that the area planted to transgenic crops could reach nearly 60 million hectares.

Ironically, it is the farmers and consumers in the low-income, food-deficit nations who have most needed the first wave of agricultural biotechnology products because they reduce production costs per unit of output. Take the example of Bt cotton in South Africa. In the past, smallholders sprayed insecticides 8 to 10 times a season. With Bt cotton they reduced spraying to one to two times a season, realizing production cost savings of up to US$140 to 160 per hectare.

Moreover, because the technology is packed into the seed, biotechnology products can help to simplify input delivery, which is often a major bottleneck in reaching smallholder farmers. But instead, the benefits have first gone to farmers in the industrialized nations, whose governments already collectively subsidize their farmers to the tune of US$360 billion per year and where many of the major problems of human nutrition are related to obesity!

Today agricultural research and development in the industrialized nations is primarily driven by private investment. Thus we are told that the fastest way is to get a new technology to poor people is to speed up the product cycle so that the technology can spread quickly, first among rich people and later among the poor. While these diffusion dynamics may well be the case, we believe that the private life science companies need to establish concessionary pricing now in the low-income countries so that poor farmers can also benefit from the new products of genetic modification technology. In addition, we believe that the large transnational companies should share their expertise with public research institutions and scientists concerned with smallholder agriculture and form partnerships to work on crops and agricultural problems not currently of priority interest in the main transnational markets.

Governments of developing nations would be well advised to establish reasonable regulatory frameworks to guide the development and use of genetically modified organisms, both to protect people and the environment. In addition, the intellectual property rights of private companies need to be safeguarded to ensure fair returns to past investments and to encourage greater investments in the future.

Standing Up to Anti-Science Zealots

Although there have always been those in society who resist change, the intensity of the attacks against genetically modified organisms (GMOs) by certain groups is unprecedented, and in certain cases, even surprising, given the potential environmental benefits that such technology can bring in

reducing the use of crop protection chemicals. It appears that many of the most rabid crop biotechnology opponents are driven more by a hate of capitalism and globalization than by doubts about the safety of transgenic plants. However, the fear they have been able to generate about biotechnology products among the public is due in significant measure to the failure of schools and colleges to teach even rudimentary courses on agriculture, especially in the industrialized nations. This educational gap has resulted in an enormous majority, even among well-educated people, who seem totally ignorant of an area of knowledge so basic to their daily lives and, indeed, to their future survival. We must address this ignorance without delay, by making it compulsory for students to study more biology and understand the workings of agricultural and food systems.

Much of the current debate about transgenic crops in agriculture has centered on two issues—safety and concerns about access and ownership. Part of the criticism about GMO safety holds to the position that introducing "foreign" DNA" into food crop species is unnatural and thus an inherent health risk. But all living things—including food plants, animals, and microbes—contain DNA. How can we consider recombinant DNA to be unnatural? Even defining what constitutes a "foreign" gene is also problematic, since many genes are common across many organisms. Obviously, it does make sense for transgenic foods to carry a label if the food is substantially different from similar conventional foods. This would be the case if there is a nutritional difference or if there is a known allergen or toxic substance in the food. But if a food made from a transgenic variety is essentially identical to regular versions of the same food, what would be the utility? To us, this would undermine the central purpose of labeling, which is to provide useful nutritional or health-related information to allow consumers to make informed choices.

On the environmental side, the present opposition to the transgenic crops carrying the *Bacillus thuringiensis* (Bt) gene seems especially ironic, since it has been promoted for more than 50 years as a "natural" insecticide to control caterpillars. But anti-GMO activists have decried the incorporation of the Bt gene into the seed of different crops, even though this can reduce the use of insecticides and is harmless to other animals, including humans. Part of their opposition is based upon the prospect that widespread use of Bt crops may lead to mutations in the insects that eventually will render the bacterium ineffective. This position seems incredibly naïve. We can be quite sure that the ability of a particular strain of *Bacillus thuringiensis* to confer insect resistance inevitably will break down, and this is why dynamic breeding programs—using both conventional and recombinant DNA techniques—are needed to develop varieties with new gene combinations to keep ahead of mutating pathogens. This has been the essence of plant breeding programs for more than 70 years.

In the United States, at least three Federal agencies provide scrutiny over the safety of GMOs: the U.S. Department of Agriculture, which is responsible for seeing that the plant variety is safe to grow; the Environmental Protection Agency, which has special review responsibilities for plants that contain genes that confer resistance to insects, diseases, and herbicides; and the Food and Drug Administration, which is responsible for food safety. The data requirements imposed upon biotechnology products are far greater than they are for products from conventional plant breeding, and even from mutation breeding, which uses radiation and chemicals to induce mutations. But there is no such thing as zero biological risk. It simply doesn't exit, which makes, in our opinion,

the enshrinement of the "precautionary principle" just another a ruse by anti-biotechnology zealots to stop the advance of science and technology.

There is no reliable scientific information to date to substantiate the idea that GMOs are inherently hazardous (ACSH 2000). Recombinant DNA has been used for 25 years in pharmaceuticals, with no documented cases of harm attributed to the genetic modification process. So far, this is also the case in foods produced with genetic modification technology. This is not to say that there are no risks associated with particular products. There certainly could be. But we need to separate the methods by which GMOs are developed—which are not inherently unsafe—from the products, which could be if certain toxins or allergens are introduced. We are witnessing the consequences of the politicization of science, seen recently in southern Africa, where transgenic maize offered as food aid has been denied starving people, on the basis of arguments that have no basis in scientific fact. This impasse over distribution of transgenic maize is truly tragic and a clear-cut case of confusing politics with science. When scientists lend their names and credibility to unscientific propositions, what are we to think? Is it any wonder that science is losing its constituency? We must maintain our guard against politically opportunistic researchers, like the late T. D. Lysenko, whose pseudo-science in agriculture and vicious persecution of anyone who disagreed with him, contributed greatly to the collapse of the former Soviet Union.

A second controversial aspect of transgenic varieties involves issues of ownership and access to the new products and processes. Since most GMO research is being carried out by the private sector, which aggressively seeks to patent its inventions, the intellectual property rights issues related to life forms and to farmer access to transgenic varieties must be seriously addressed. Traditionally, patents have been granted for "inventions" rather than the "discovery" of a function or characteristic. How should these distinctions be handled for life forms? Moreover, how long and under what terms should patents be granted for bio-engineered products? These are serious issues that need to be addressed, both by the World Trade Organization and by individual governments.

The high cost of biotechnology research is leading to consolidation in the ownership of agricultural life science companies. Is this desirable? We must confess to uneasiness on this score. We believe that the best way to deal with this potential problem is for governments to ensure that public research programs, geared to produce "public goods," are also adequately funded to help ensure that farmers and consumers cannot become hostages to possible private-sector monopolies. Unfortunately, during the past two decades, support to public national research systems in the industrialized countries has slowly declined, while support for international agricultural research has dropped so precipitously as to border on the disastrous. If these trends continue, we risk losing the broad continuum of agricultural research organizations—public and private and from the more basic to the more applied—that are needed to keep agriculture moving forward.

Opponents of biotechnology are now trying to convince Third World nations that their plant species are at risk of being stolen by the private-sector gene prospectors—biopirates—and are recommending legal barriers to stop the flow of germplasm. This is unfortunate. Over the past 500 to 600 years, the concept of what constitutes "indigenous" germplasm has been greatly blurred. Maize, beans, groundnuts, cassava, potatoes, cocoa, and peppers—to name only a few—were originally domesticated in the

Americas and spread by explorers and traders throughout Europe, Asia, and Africa. From Asia, rice, wheat, barley, oats, rye, soybeans, chickpeas, and peas spread to other continents. From Africa, sorghum, millet, and coffee spread from around the world. Thus, historically speaking, all nations are "bio-pirates" in one way or another. We say hooray for that, since this has brought tremendous diversity and improved nutrition to our diets.

Agriculture and the Environment

It is true, of course, that agricultural intensification over the past 40 to 50 years also has had adverse effects associated with it. Increasing water scarcity and soil degradation affect large tracts of agricultural land, especially in Africa and Central America. Irrigated agriculture, which accounts for 17 percent of the cultivated area but contributes 40 percent of our food supply, has contributed to waterlogging, salinization, and depletion of soils and chemical contamination of surface and groundwater supplies. Intensive livestock production has created problems of manure disposal and water pollution. Fisheries have been overexploited. All of these problems are solvable—and often through civil engineering solutions rather than agricultural technology solutions, per se.

To be certain, we all owe a debt of gratitude to environmental movement in the industrialized nations, which has led to legislation over the past 35 years to improve air and water quality, protect wildlife, control the disposal of toxic wastes, protect the soils, and reduce the loss of biodiversity. Rachel Carson's book *Silent Spring* in 1962, which reported that poisons were everywhere, struck a nerve. Of course, this perception was not totally unfounded. By the mid-20th century, air and water quality had been seriously damaged through wasteful industrial production systems that pushed effluents often literally into our own backyards.

However, we agree also with environmental writer Gregg Easterbrook, who argues that, "In the Western world the Age of Pollution is nearly over . . . . Aside from weapons, technology is not growing more dangerous and wasteful but cleaner and more resource-efficient. Clean technology will be the successor to high technology" (Easterbrook 1995). However, he goes on to warn that, "As positive as trends are in the First World, they are negative in the Third World. One reason why the affluent nations must shake off their doomsday thinking is so that resources can be diverted to ecological protection in the developing world."

Notwithstanding the problems of intensive agriculture, we often ask the critics of modern agriculture what the world would have been like without the technological advances that have occurred, largely during the past 40 years? In particular, we cannot ignore that world population has more than doubled over the last 50 years. For those whose main concern is protecting the "environment," let's look at the positive impact that applying science-based technology has had on land use. By increasing yields on the lands best suited to agriculture, world farmers have been able to leave untouched vast areas of land for other purposes. For example, had the global cereal yields of 1950 still prevailed in 1999, instead of the 650 million hectares that were used for production, we would have needed nearly 1.8 billion hectares of land of the same quality to produce the current global harvest (fig. 1). Obviously, such a surplus of land was not available, and certainly not in populous Asia, where the population has increased from 1.2 to 3.8 billion over this time. Moreover, had more environmentally fragile land been brought into agricultural production, the impact on soil erosion, loss of forests and grasslands, biodiversity, and

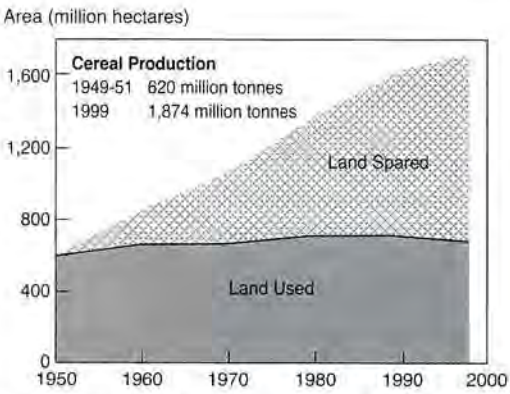

Fig. 1. The area of land the world's farmers spared from cereal production by raising yields. Source: FAO Production Yearbooks.

extinction of wildlife species would have been enormous.

Indeed, the alarming rate of deforestation in much of the tropics is the result of the *failure* to introduce high-yield agriculture, rather than caused by it. Faced with nutrient mining on inherently low-fertility croplands, many farmers in tropical areas must abandon a plot after two or three seasons of cultivation and bring new lands into production—often through slashing and burning forestlands.

In addition to the loss of biodiversity and the soil erosion resulting from deforestation, Pedro Sanchez, the 2002 World Food Prize Laureate and former director general of the International Center for Research in Agroforestry, estimates that the burning of tropical forests annually releases about 1.6 billion tonnes of carbon, one of the most damaging greenhouse gases contributing to climate change, into the atmosphere (Sanchez 2000).

Healthy, vigorously growing, plants—trees and shrubs, food crops, and grasses—trap large quantities of carbon in the process of photosynthesis. Thus, better management of croplands (and forests) can counteract effects of climate change. Sanchez contends that if 10 percent of the world's farmers adopted conservation tillage on existing croplands, improved management of animal grazing areas, used low-impact forest harvesting techniques, and adopted agroforestry, 700 million tonnes of additional carbon would be trapped each year, which is about 10 percent of all the carbon that enters the atmosphere annually.

The debate between agriculturalists and environmentalists over what constitutes "sustainable agriculture" in the Third World has confused, if not paralyzed, many in the international donor community who, afraid of antagonizing powerful environmental lobbying groups, have turned away from supporting science-based agricultural modernization, which is still needed, especially in sub-Saharan Africa. This deadlock must be broken. We cannot lose sight of the enormous job before us to feed future generations, 90 percent of whom will begin life in poverty.

While the affluent nations can certainly afford to adopt ultra low-risk positions toward new advances in agricultural science and technology and to pay more for food produced by the so-called organic methods, nations with chronically undernourished people cannot. Only dynamic agricultural development will give sub-Saharan Africa any hope to alleviate poverty, improve human health and productivity, and avoid political and social chaos. Moreover, higher incomes will permit small-scale farmers to invest more in protecting their soil and water resources. Kenyan archeologist Richard Leakey likes to reminds us that you have to be well fed to be a conservationist (Comments on Sustainable Development 1992, 164-166). We need to bring common sense back into the debate on agricultural science and technology, and the sooner the better.

Closing Comments

President Obasanjo of Nigeria, himself a farmer, served on the SAA Board of Directors for 8 years, as a private citizen. Permit

us to quote him on African agriculture, since we share his perspective: "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. I want to see people encouraged. I want to see the evolution of young, emergent, commercial farmers who will be holding, not a half-hectare of land, but 5 to 10 to 20 hectares of land, and for whom the city will have no big attraction" (Policy Recommendations 1994).

We believe that there has been far too much "minimalist" thinking about African agricultural development in recent years. It's time that we started implementing aggressive and dynamic field programs that can help African farmers to prosper and not just survive. Intensification of food production, using modern technologies on the lands best suited to this use, must be at the heart of these efforts. This outcome can be achieved if we work in true partnerships—farmers, extension workers, and scientists; public, private, and nongovernmental organizations; and national governments and international agencies.

Africa is a sleeping agricultural giant waiting to be awakened. The potential is there but you can't eat potential. To realize this potential will require greater investments in agricultural research, extension, infrastructure, transport, general education, and health. While greater investments in all of these areas are necessary, improving rural transport systems may be the most critical component for moving farmers from a subsistence way of life to a more prosperous life of small-scale commercial agriculture.

We have the knowledge to make African agriculture bloom and prosper. What we need is the political, financial, and institutional will to ensure that science and technology can be put to work in the service of the smallholder farmers and poor consumers of this vast continent.

In closing, let us remember the words of Nobel Peace Laureate, Lord John Boyd Orr, the first director general of FAO, who warned us, "You cannot build peace on empty stomachs."

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Agricultural Intensification Program in Ethiopia

Belay Ejigu

The New Partnership for Africa's Development (NEPAD) is a framework for and the banner of the struggle for structural transformation of Africa's politics and economics. It is the framework for global partnership for Africa's development. It is a real and new partnership that is based on the pursuit of common interest and mutual obligations and accountability. It is also a framework that has to be developed into blueprints in each African country. Thus, its outcome will depend on how effectively we interpret and implement it.

We have also recognized that the economic strategies of NEPAD can serve as guidelines in the struggle for economic transformation.

In 1992, the government of Ethiopia initiated several changes in the policy environment and in organization of the economy. The changes were aimed at replacing erroneous policies of the past. The reforms called for significantly reducing the role of the state in production and trade, encouraging the private sector, and shifting from a command economy to a free-market economic system.

To rehabilitate and revitalize the economy in general and agricultural development in particular, the Federal Democratic Republic of Ethiopia has, since 1993, pursued a development strategy called Agricultural Development-Led Industrialization (ADLI). This strategy strongly assumed that in Ethiopia a kickoff in agriculture would trigger the development of other sectors like industry and services. ADLI is designed to secure three interrelated visions—sustainable economic growth, equity, and self reliance—through the delineated development priorities: food self-sufficiency and food security, natural resource conservation and management, expansion of economic and social infrastructure, encouragement of private participation, and non-economic stability.

ADLI aims to transform the country's economy from an agricultural base to a nonagricultural base. Agriculture is expected to play a leading role to enhance its contribution to economic growth on both the supply and demand sides. On the supply side, the sector provides food and export products, as well as industrial raw materials. On the demand side, it stimulates the purchasing capacity of the people and encourages industrial expansion by providing markets for domestically produced goods and products.

The contribution of the two sides for agriculture is enhanced through improvements in the productivity of peasant farmers and pastoralists and through the establishment of large-scale farming. Primarily by opening up a productive role to smallholders and capitalizing on the growth and employment multipliers induced by the growth of agricultural income, the sector

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development process has thus broken down into a three-pronged approach. First, it focuses on improving traditional agriculture practices by directing resources and supports to enhance productivity improvements through effective utilization of the natural resources base. Second, it focuses on encouraging the diffusion of technological change by enhancing investment in economic and social infrastructure. Third, it focuses on creating a conducive policy environment for investment in order to expand employment opportunities for the growing rural labor force.

Recognizing that agriculture and rural development require an enabling macroeconomic policy framework, the government has instituted reforms in monetary and fiscal policies, investment and trade policies, and sector policies. It has changed policies related to fertilizer, seed, agricultural research, and food security, and it has created a national agricultural extension program.

The national agricultural extension program, also known as the extension package program, has been implemented since 1995. Its goal is attaining self-sufficiency in food production. Before launching the extension package program, the extension field staffs of the ministry and SG 2000 carried out a 2-year pilot demonstration, and the results were impressive. SG 2000 played an indispensable role in Ethiopia by demonstrating to farmers the possibility of increasing crop productivity. Following the new Participatory Demonstration and Training Extension System, the package approach to development was adopted. All essential components, such as information on agriculture technology, production inputs, and credit are provided to farmers as a complete set.

In addition, the program conducted demonstrations of a persuasive size in various agricultural development activities and adopted a cluster-diffusion strategy in which demonstrations are conducted in a particular area and from there on knowledge is diffused through farmer-to-farmer extension and organized field days. The Participatory Demonstration and Training Extension System also entails strong research-extension-farmer links, as well as proper supervision and evaluation. Annual evaluations have been carried out since the launching of the extension package program to identify the constraints and make improvements, building upon the identified constraints.

The extension program was initiated in 7 of the 11 regional state governments and councils with a crop technology package for high rainfall areas. In subsequent years, packages for crops in moisture-stressed areas, livestock, high-value crops, post-harvest technology, agroforestry, and soil and water were included.

Thus, we have recognized that the extension package program helps small-scale farmers improve agricultural production and productivity through the dissemination of research-generated technologies and information.

The results are encouraging. Yields of staple food crops like teff, maize, wheat, and sorghum are two to four times greater than those obtained by traditional methods (table 1). In addition, the number of participating farmers in the package program increased from 32,000 in 1995 to about 4.2 million in 2002 (table 2). The use of agricultural inputs, especially fertilizers and improved seeds, also increased significantly (table 3).

Our success story rests on an environmentally conscious agricultural intensification program that acknowledges the use of inorganic fertilizer and improved seeds, on a suitable extension strategy and packages developed to address the needs of rural communities, on the commitment of the government to agricultural development,

Table 1. Ethiopian crop yields, improved (imp.) compared with conventional (conv.) practices, 1995–2001 (t/ha).

Year	Maize		Wheat		Sorghum		Teff		Barley	
	Imp.	Conv.	Imp.	Conv.	Imp.	Conv.	Imp.	Conv.	Imp.	Conv.
1995	3.7	1.0	2.9	0.9	2.7	0.8	1.3	1.0	-	0.8
1996	5.4	1.7	2.8	1.2	4.5	1.4	1.5	0.8	-	1.1
1997	3.7	1.7	3.5	1.3	1.9	1.0	1.7	0.9	1.7	1.1
1998	5.2	1.6	2.5	1.4	3.0	1.1	1.3	0.7	2.1	1.1
1999	5.8	1.8	3.0	1.2	1.9	1.1	1.4	0.8	2.7	1.5
2000	4.1	1.7	2.6	1.2	2.1	1.0	1.7	0.8	1.9	1.0
2001	3.7	1.1	2.4	1.1	2.1	0.8	1.3	0.6	1.7	0.9

and on coordination among the institutions involved in agricultural development.

Despite the successes of the extension package program, the sustainability of our agricultural development faces environmental challenges (associated with natural resources degradation), as well as technological and institutional challenges and overdependence on rainfed agriculture.

Farmers recognize that although their shift to production strategies involving high levels of external input use, particularly for some staple food crops, enabled them to obtain much higher yields, it also exposed them to higher costs and risks with serious levels of indebtedness. This situation has been caused by the dramatic declines in prices for many cereals in local markets as a result of high yields and increased supply to the market after good rainfall years. Increasing prices of agricultural inputs and decreasing prices for farm produce along with recurrent drought over the program period have made farmers vulnerable to shocks.

Farmers are burdened with the huge cash outlay required for inorganic fertilizer, and poor infrastructure (road network, transport services, and marketing facilities) has adversely affected the timely delivery of fertilizer to the right place in the required quality and at an equitable price.

Smallholder farmers in Ethiopia are facing challenges in dealing with a liberalized market. The most common complaints are lack of proper storage facilities to take advantage of better off-season prices, lack of vital market information, and inadequate rural credit.

As a result, the government formulated different strategies in its second 5-year development program. The program features agroecology-based and client-oriented packages. The broad agroecologies to be covered are reliable moisture, moisture deficit, and pastoral areas.

To increase food production in reliable rainfall areas, the diffusion of technology packages within smallholder agriculture is

Table 2. Number of farmers (000) participating in national extension programs, Ethiopia, 1995–2001.

Year	Food crops	High economic value crops	Livestock	Post-harvest technology	Natural resources	Total
1995	32	–	–	–	–	32
1996	350	–	–	–	–	350
1997	584	23	22	0.1	9	638
1998	2,122	275	45	0.2	544	2,987
1999	2,804	390	67	1.0	546	3,808
2000	2,987	387	77	1.2	342	3,794
2001	2,616	441	89	1.7	–	–

Table 3. Farm inputs used by national extension programs, Ethiopia, 1995–2000.

Year	Improved seed (000 t)	Fertilizer (000 t)
1995	2.4	35
1996	6.8	–
1997	7.7	53
1998	13.6	196
1999	17.8	217
2000	18.2	230

considered important. In these areas, technical opportunities for raising farm outputs are reasonably well understood, and there are generally good yield responses to the use of improved seed and inorganic fertilizers. The opportunities for improving livelihoods in such areas will tend to come from shifting, where markets permit, from subsistence production of grains toward labor-intensive cultivation of high value commercial crops and increased diversification into livestock.

In moisture-deficit areas, addressing food security is the major strategy where the primary solution is to be found within agriculture. In these areas, moisture conservation practices are essential for enhancing agricultural development activities. In addition, the use of drought-tolerant crop varieties, high economic value crops, and animals is given due consideration.

In the pastoral area, the major agricultural activity is livestock, and all agricultural development activities will center on this fact. Strengthening livestock marketing is also an vital part of the food security strategy of pastoral areas.

To carry out those strategies, two types of packages are being developed. The first package groups are those to be implemented by existing farm households, utilizing the existing technologies and management skills of these farmers. The second package groups are those to be implemented by educated and well-trained farmers, and they are of high-level technologies. The cross-sector issues, dealing with system analysis, include inputs supply and credit, marketing, and regulations and standardization. Efforts are also under way to integrate packages around major activities like water harvesting, coffee, dairying, and agroforestry. These packages will focus on the household for implementation.

The package development teams have integrated information from indigenous knowledge practices, the Ethiopian research system, the international research system, literature review, and experience from other countries. These packages are to be implemented at household level and will be reorganized into extension packages based on identified major activities as entry points and will be made available as a menu to be chosen by farmers. Thus, a household survey to assess the needs of target groups is under way. Following the survey, farmers will be classified into different recommendation domains based on their situations.

Establishing farmers' training centers is part of the agricultural technical, vocational, and education program. They are expected to accelerate transformation to market orientation. The main objective is to create and develop human resource and institutional capacity that will have a beneficial impact over the medium- and long-term capacity. The farmers' training centers will serve as centers for skills training and demonstrations for diffusing these technology packages.

The dependence of agriculture on rainfall, the variability in output, food insecurity, and hence the variability of the overall growth of the economy remain critical economic problems and the cause of dependence on food aid. This situation underscores the need for expanding efforts in water management and natural resource management where soil conservation together with other measures will be harnessed to enhance productivity.

Generally, the government intends to transform the rural economy from subsistence to market-based production in which farming is seen as business rather than a way of living. To this effect, the government has recognized that the transformation requires maintaining synergy among the components of agricultural research and extension, cooperative development, rural finance, rural roads, capacity building, agricultural marketing, and land administration and management.

Above all, the commitment and conviction of the government to bring change in the livelihood of the people have contributed a lot to the success.

Sharing Good Practices in Agricultural Modernization

W. Kisamba-Mugerwa

Many countries have undergone economic recovery programs with varied outcomes and similarities. This paper attempts to convey the experiences that led to the formulation of Uganda's Plan for the Modernisation of Agriculture, the processes for its implementation, and its impact on the economy and farmers' lives. The Plan for the Modernisation of Agriculture (PMA) is a framework based on principles, policies, and institutional arrangements agreed on by all stakeholders, including the donor community. The initiative for PMA was derived from Uganda's Poverty Eradication Action Plan, the flagship of Uganda's economic recovery program for the last 16 years. Although the PMA is in the early stages of implementation, there are lessons to be drawn from its weaknesses and strengths.

Agriculture in Uganda

The people of Uganda have always relied on agriculture as their principal livelihood. Eighty percent of the population live on the land, and agriculture contributes 41 percent of Uganda's GDP of which 60 percent is from food crops. More than 80 percent of export earnings is from agriculture. Coffee, cotton, and horticulture are the three major sources of income. Over the past decade, Uganda's economy has grown at an average annual rate of 6.1 percent. The agricultural sector has grown 3.4 percent a year, some 0.5 percent above population growth. The budget allocation to agriculture reached a peak of 4.4 percent in 1999/2000 budget and is expected to grow into double-digit numbers in the medium-term expenditure framework, provided that economic stability is maintained. Inflation has been controlled and is stable at 6.6 percent. Commercial bank lending rates are 18 to 22 percent. Credit is available but rarely used by small-scale farmers because there are no appropriate institutional mechanisms that make it accessible and affordable to them.

Uganda's balance of payments is improving due to debt relief under the Heavily Indebted Poor Countries Initiative. Independent studies have shown that funds released from debt payments are being effectively allocated directly to the rural poor through the Poverty Action Fund. This outcome was made possible by the institutional arrangements, funding mechanisms, and capacity-building programs that have resulted from a continuing process of constitutionally backed decentralization. The sources of funding to agriculture include:

- a separate development budget to the Ministry of Agriculture for policy formulation and regulatory activity; and also to districts for implementation
- direct funding to affiliated semi-autono-

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mous institutions that provide strategic services and farmer empowerment through capacity building

- nonsectoral conditional grants to promote synergy and agricultural growth synchronized with other sectors
- projects outside the medium-term expenditure framework

Uganda's Development Paradigm

Uganda had an early period of prosperity after independence that was severely disrupted by a series of successions in government. Uganda's past attempts to stimulate national economic growth through agricultural growth were stifled by mismanagement, misguided policies, and civil unrest. Since 1986 when the NRM government gained power, however, there has been a clear set of principles, priorities, and policies for economic growth that have poverty reduction is a direct goal. Consultations revealed a ranking of the causes of poverty in Ugandan society (table 1). Consequently macroeconomic reforms were undertaken under the Poverty Eradication Action Plan, which provided a comprehensive framework for development and also guided sector intervention plans. The government expects to reduce poverty to 10 percent by 2017.

Uganda's development paradigm was defined by the conviction of its leaders that economic transformation must begin with modernizing agriculture and concurrently developing industries that build on demand and supply links to agriculture. Such socioeconomic transformation is predicated on the participation of the poor in economic growth that is sustainable, and it also addresses nonmaterial aspects of poverty, such as insecurity, illness, isolation, and disempowerment. This analysis was informed by poverty reduction studies and underlies the formulation of the Poverty Eradication Action Plan whose goals are to:

- create a framework for economic growth and transformation
- ensure good governance and security
- increase the ability of the poor to raise incomes
- increase the quality of life of the poor

This planning framework is also consistent with creating an enabling environment for generation of wealth that benefits both the poor and the rich as members of the same community.

Table 1. Causes of poverty cited by farmers in rural areas of Uganda.

Factor	% of rural sites
Lack of access to markets	63
Poor health	58
Lack of education and skills	58
Excessive alcohol consumption	54
Ignorance/lack of information	54
Lack of access to financial services and capital	42
Large families	42
Insurgency	38
Idleness (rebels and rustlers)	33
Lack of cooperation	17

Assumptions Underlying Reform Expectations

The PMA approach assumes that enabling farmers to use improved technologies will lead to increased factor productivity. It also assumes that increased farmer productivity should lead to increased incomes and disposable income. That income, if spent on nonfarm goods and services, will stimulate employment, production, and growth in off-farm sectors of the economy. Modernizing agriculture will therefore have a pervasive impact throughout the economy by introducing profound technological change throughout the sector. This technological change will keep pressure on real food prices, thereby raising real incomes of the poor. Ultimately lower unit costs of production should increase rates of economic growth and also Uganda's agricultural competitiveness on international markets, provided that other things are equal.

Plan for the Modernisation of Agriculture

The PMA lays out a set of principles that govern government actions for developing the rural sector. It also describes a new holistic and multisectoral institutional framework for promoting rural livelihoods. PMA is a multisectoral approach for transforming agriculture through a planning and budget process that begins from the lower levels of government that are directly connected with farmers' institutions. In addition to coordinating the nonsectoral conditional grants to support agriculture, PMA identifies seven areas for emphasis during implementation:

- research and technology development
- national agricultural advisory services
- agricultural education
- improving access to rural finance
- agro-processing and marketing
- sustainable natural resource utilization and management
- physical infrastructure

The seven priority areas can be grouped under three themes: increased use of knowledge-led agriculture, greater availability of agricultural inputs, and access to markets for agricultural produce.

The PMA is a direct attempt to transform the prevalent subsistence farming to a market-oriented farming. Its objective is to increase the ability of the poor to raise their incomes and improve the quality of their lives.

Institutional Arrangements for Implementing PMA

The PMA was derived from the Poverty Action Eradication Plan (PEAP) as a cornerstone strategy for multisectoral growth. Uganda consequently developed and launched PMA as a highly focused but well-integrated policy framework for increasing agricultural productivity as the basis of economic growth, poverty reduction, and food security. The PMA was officially launched in 2001 when the PMA forum and the PMA steering committee were formed. Both these organs for managing the PMA process have representatives from 12 key government ministries and agencies as well as the private sector and civil society. The PMA secretariat reports to the PMA steering committee, which is housed in the Ministry of Finance. A subcommittee of the PMA steering committee, called the development committee, is responsible for reviewing all programs to ensure compliance, irrespective of the source of funding.

Uganda and donors also agreed a set of principles to raise the quality of their partnership in support of PMA and PEAP (table 2). The main principle is that donor support will only be sought for programs that are in line with the Poverty Eradication Action Plan. These principles demand a new mode of operation that encourages donors to modify their support to existing programs and NGOs in order to conform to the framework. Interventions to support PMA objectives must therefore demonstrate capacity to achieve greater farmer empowerment; decentralized allocation of resources; publicly funded, privately delivered services; cost sharing by clientele; partnerships based on a multisectoral approach; incorporation of crosscutting development issues (HIV/AIDS and gender issues); and a participatory mechanism of monitoring and evaluation.

The National Agricultural Advisory Services (NAADS), a first generation of programs derived from the PMA, was launched in 2001/02. Other programs like the National Agricultural Research Organisation and existing donor and NGO projects are being adjusted to conform to PMA principles. A rollback process will be instituted for programs that fail to work within the PMA framework.

Table 2. The basis for partnership between Uganda and development agencies.

Government will:
• Increase focus on poverty eradication
• Focus on tax collection—increase revenue base
• Assume leadership and responsibility for donor coordination process
• Insist on PMA compliance for all donor and NGO projects and roll back stand-alone donor projects
• Strengthen monitoring and accountability for all programs
• Continue to improve transparency and combat corruption
• Continue to strengthen district capacity
• Develop and cost comprehensive, prioritized sector-wide programs eventually covering the whole budget
• Further develop participation and coordination of all stakeholders
• Strengthen capacity to coordinate across government (so it speaks with one voice)
And donors will:
• Jointly undertake all analytical work, appraisals, and reviews
• Jointly set output/outcome indicators
• Develop uniform disbursement rules
• Develop uniform and stronger accountability rules for funds issued
• Ensure all support is fully integrated into sector-wide programs and is fully consistent with each sector program's priorities
• Continue to increase the level of untied budget support
• Increase delegation to country offices—reduce bureaucracy
• Abolish topping up of individual project staff salaries
• End individual and parallel country programs and stand-alone projects
• Progressively reduce tying of procurement to source of funds

Trends in Reforms and Agriculture

The macroeconomic reforms have revitalized Uganda's economy and improved its international credit rating and standing in the global economy. Although the economy is still small (US$2 billion GDP per annum), it has demonstrated strong growth, averaging 6.1 percent annually over the last 10 years. The consistency of this trend suggests an underlying increase in Uganda's capacity to manage the economy and also validates the development vision and policies that are in place. The contribution of agriculture to economic growth has been highly significant. Agriculture has grown 3.4 percent a year over the last 10 years. Although agriculture remains the mainstay of Uganda's economy, its contribution has decreased from 61 percent in 1985 to 49 percent in 2001. This change is in part the result of success in rehabilitating the rest of the economy, especially manufacturing and service industries.

The positive growth rates of the economy to which agriculture continues to make a significant contribution result from improvements spread over the entire agricultural sector. The crops, livestock, and fisheries sectors have especially contributed to agricultural growth. Although the crop sector continues to be the dominant source of growth, there is increasingly strong contribution from nontraditional export crops, especially horticultural products. It is now clear that the area planted to food crops has increased in response to the price incentives provided by new market opportunities that were created by the process of liberalization. One direct consequence, however, is that greater food production has been mainly due to expansion in area rather to higher crop yields.

This pattern suggests that expansion of the cropped area by promoting plows and small tractors must be contributing more significantly to increase in labor productivity. And it raises questions about the emphasis placed on yield increase by the PMA and NAADS. Undoubtedly there are location-specific impacts on yields of specific crops, as has been amply demonstrated for maize, beans, and groundnuts in the SG 2000 and IDEA projects. Such impacts, however, are engulfed in the national averages because the scale of these interventions is limited.

PMA provides a means by which districts can alleviate key constraints to production and productivity increase at the sub-county and farm household level. NAADS now provides a framework by which such location-specific impacts on yield can be scaled up to the national level through elective participation of farmers groups in selected enterprises.

Performance of PMA

PMA has provided a key instrument for strengthening the national production base. Sixteen percent of Uganda's 2001/02 budget was allocated to PMA priority areas. Nine percent of the PMA allocation was directly transferred to districts. Although the share of the budget allocated to agriculture may not have increased, the PMA contributes to increasing the relative expenditure of the districts for agriculture. Under PMA, the government allocated U Sh 2.0 billion to 17 districts in 2000/01 and a further U Sh 4.4 billion in 2001/02 to directly overcome significant barriers to agricultural growth. A total of 132 PMA-related projects were carried out by districts. Districts with strong leaders employed these funds effectively to alleviate the most pressing constraints to agricultural production. However those districts where the leaders lacked the vision did not perform so well and used these funds in a more general way.

Capacity to plan and manage these funds to synchronize growth of agriculture with other sectors must be improved at the district and community level. The Ministry of Local Government has earmarked funds for districts to recruit community development workers who help synchronize use of PMA grants targeted to agriculture. PMA has now developed a framework for monitoring and evaluating its progress in relation to performance of implementing agencies, for assessing beneficiaries of intermediate outcomes as indicated by household surveys, and for assessing final outcomes or impacts on poverty reduction contributions to PEAP. Under PMA a food security and nutrition policy has been drafted and submitted for approval in Parliament.

A joint review on the progress of PMA by the government and donors led to recommendations on issues in the seven priority areas of the PMA, as well on issues that hinder implementation. As a result, specific initiatives have been proposed that could form the basis of future plans for modernizing agriculture and also feed directly into programs of other ministries and overall government policies. Among them are measures being taken to increase private participation in the PMA programs, initiatives to increase the bargaining power of poor farmers by forming privately registered marketing groups, and development of a regional transport policy. The recommendations to develop legal and regulatory frameworks for liberalization of research and also appropriate policies and laws on biotechnology and genetically modified organisms for use in agriculture are being carefully considered and are open to public debate.

Developments in PMA Priority Areas

The PMA steering committee in consultation with stakeholders continues to develop national strategic plans for intervention in the seven priority areas. Some national plans like the National Agricultural Advisory Services (NAADS) and infrastructure are already under way. Others are at various stages of completion.

Agricultural Advisory Services

NAADS was launched in 2001 with a goal of decreasing the proportion of subsistence farmers from 82 percent to 40 percent within 25 years, while increasing the proportion of commercial farmers from 5 percent to 20 percent. The remaining 40

percent will be commercially oriented farmers of small to intermediate scale. A key tenet of the NAADS program is that public funds will be used by private providers to deliver agricultural services to poor farmers. Continued funding of the service will depend on its effectiveness in reaching the target clients and producing the desired outcomes in productivity increases.

NAADS implementation in 2000/01 covered six districts. Private service providers participated in NAADS to deliver advisory services for farmer institutional capacity building and technology transfer to 24 sub-counties on a pilot basis. Farmers confirmed that funds for their activities were received and used at sub-county level. Farmers were also satisfied that most service providers did a good job of building of farmers' groups and developing plans for agricultural enterprises. Specialized NGOs that operated as service providers produced much better quality work than general NGOs and community-based organizations. Therefore greater emphasis on the training and capacity building of service providers is needed, especially in the more technical aspects of technology transfer. NAADS has engaged SG 2000 to help build the capacity of service providers as NAADS expands its coverage to all districts over the next 4 years. A service providers' register is being compiled listing professionals drawn from NGOs, community-based organizations, and agricultural education, research, and development institutions.

The lessons learned point to the need for a sound policy and operational framework to help synchronize implementation of the various elements of the PMA, local government, and central government to achieve greater coherency with NAADS.

The sequence of events—from developing farmers' institutions, work plans, and enterprises to technology transfer contracts—needs to be better synchronized in current and future pilot districts. Developing the demonstration content of NAADS technology transfer contracts should be reviewed to ensure that the agenda for productivity increase is fulfilled adequately. It is especially important to build capacity to source technologies from the national research organization and other relevant research organizations, even private ones.

Agricultural Research and Technology Development

The PMA steering committee has initiated a review of the national agricultural research system in relation to PMA principles and objectives. A particular concern is to make the research system responsive to a more comprehensive perception of productivity increases at the farm level so that it develops a broader range of technology innovations beyond crop varieties. Technology innovations must also give greater priority to the needs of poorer farmers and more marginal production environments.

A reorganization of the national research system is in progress. An agricultural research council has been proposed as an apex body to oversee and allocate funds for all agricultural research. The secretariat of the National Agricultural Research Organisation will be housed in the council as a subcommittee to coordinate six national strategic research centers. These centers will compete with other stakeholders for research grants. Six zonal adaptive research and development centers will be maintained but will have to compete for research grants allocated to districts specifically for their research needs. The centers will also run technology development sites at the sub-county level and have strong links with NAADS service providers. The key technology development themes in their 5-year plan are food security, stability of productivity increase, and optimal use of water for production in marginal environments.

Access to Rural Finance

Smallholder farmers perceive lack of access to rural finance as a major barrier to investing in productivity-enhancing technologies. Financial reforms begun in 1991 have increased the outreach and depth of Uganda's financial sector disproportionately. Although formal banking itself is awash with liquidity, there has been little monetization of the informal sector, which remains a large part of the economy. As a consequence of the dependency on commercial banks for financial services, the share of loans extended to agriculture diminished from 19.5 percent in 1996 to 6.4 percent in 2001, while the share to manufacturing increased from 26.7 percent to 33.5 percent. The PMA has pressed for the passing of the Microdeposits-taking Institutions Bill to increase mobilization and intermediation of public deposits and incorporate them into the financial sector. The bill allows the third-tier class of microfinance institutions regulated by the Bank of Uganda to provide savings and credit services. It also permits a fourth tier of microfinance institutions that will not be regulated or supervised by the Bank of Uganda. Consequently they will not generally be permitted to mobilize voluntary deposits or savings for intermediation. They will however be allowed to collect forced savings as part of a lending methodology. It is hoped that the latter category of microfinance institutions will be more suited to the needs of producer associations and special interest groups of farmers, and thus make available more financial services to farmers.

A 3-year Rural Financial Services Outreach Program worth U Sh 16 billion will be started in 2002/03. A complementary IFAD-funded Rural Financial Services Program has also been negotiated and will run for 7 years beginning in 2002/03. The program is intended to expand rural financial services in all districts of Uganda over 3 years through building the capacity of microfinance institutions. There is however no guarantee that this will lead to increased lending to the agricultural sector; it is only an assumption.

Agro-processing and Marketing

The PMA has developed a strategy to promote agro-processing and marketing in collaboration with the Ministry of Tourism, Trade, and Industry. Noteworthy areas of intervention are building national capacity for trade policy and negotiations, market information, farmer organizations, and export competitiveness. Funding for these key activities will be available in the 2002/03 budget on the explicit understanding of what are appropriate roles for private sector and government in a free-market economy.

The government continues to assure the private sector that there will be no going back on the policies of liberalization and privatization. The government has built the confidence of the private sector by supporting the formation of Uganda Grain Traders, a private grain trading company with access to facilities and finance to export 40,000 tonnes of maize grain to Zambia and Malawi in 2001. Such intervention was necessary to forestall a significant decline in maize production following a crash of maize prices after three consecutive bumper crops. Uganda Grain Traders now announces the amounts of grain for export orders and floor prices for maize and beans ahead of every season on the basis of international grain trading markets. Farmer interest in maize production has revived somewhat. The impact may be more significant in the 2003 crop season.

The resolution of market prices is however only one part of the solution. Farmers must be organized in order to negotiate the best prices from middlemen. This perennial problem will be partially solved with the NAADS interventions to form farmers'

groups and associations. More significant progress can be made through interventions of NGOs and apex bodies representing farmers. In this regard the pilot one-stop centers developed by SG 2000 have much promise. NAADS and SG 2000 are examining ways to incorporate this concept under the NAADS program. The strategy for agricultural input marketing (AIMS), which was jointly developed by PMA, IFDC, USAID, and SG 2000, is also being considered as a means of giving rural farmers access to inputs.

Natural Resources

In 2001, to help implement Uganda's Land Act of 1998, the PMA subcommittee on natural resources in collaboration with the Ministry of Lands, Water, and Environment supervised studies on three fronts: common property resources, gender and family issues and land rights, and land market consolidation and readjustments. The cabinet subsequently approved a land-sector strategic plan for implementation over 10 years beginning 2002/03.

Other studies have been commissioned to develop plans for integrating environmental concerns in PMA and all other government programs. Consultancy work has started on development of a strategy for water for production under auspices of Danida, SIDA, and the Government of Uganda.

Agricultural Education

Work on an agricultural education strategic plan started in 2002. The program coordinator of the Sasakawa Africa Fund for Extension Education is providing some input. The Ministry of Education and Schools in conjunction with Danida is funding work on this priority area of the PMA.

Physical Infrastructure

The Ministry of Energy and Mineral Development launched a 10-year program in 2002 to support rural transformation by supplying rural energy and electrification. The Energy for Rural Transformation Programme has a rural information communication technology component, which aims to spread communication facilities and networks. The PMA subcommittee on physical infrastructure is coordinated closely with the Ministry of Works, Housing, and Communications to ensure agricultural concerns have high priority in the strategy for constructing and maintaining district and community roads.

It is now expected that the PMA subcommittees will advise the Ministry of Agriculture and the PMA steering committee in the Ministry of Finance of the specific potential agricultural contribution of any programs undertaken in any ministry. The PMA steering committee, which is chaired by the permanent secretary to the treasury, will also ensure that current and new funding are properly targeted to the seven priority areas within the context of well-articulated national strategic plans.

Transferability of Uganda's Experience and Programs

The relative success of Uganda's economic recovery program has encouraged experimentation with a multisectoral development framework that seeks to maximize support for agricultural modernization. The contribution from agricultural sector has been highly significant, but it was largely the result of area expansion and increased labor productivity. New incentives are needed to stimulate further agricultural growth especially through yield increases. The multisectoral planning framework now must focus on developing and implementing national strategic plans in the seven key areas of the PMA to achieve greater agricultural productivity. The emphasis on market-driven production is one approach. In this regard the agroecological diversity and

robust food base of Uganda gives confidence that it can pursue market incentives as a means for driving production. The resulting reorientation of advisory services and research technology innovation to meet demand-driven goals is an experiment in achieving greater relevance, effectiveness, and efficiency of Uganda's strategic policy instruments for realizing the goal of poverty reduction through increased incomes and food security.

Although it is too soon to evaluate the results of these programs, significant management gains from the PMA and NAADS approaches are already evident. A clear development pathway that harnesses donor efforts and avoids duplication has been opened. Incremental investments can now be targeted to alleviate area-specific agricultural constraints at the grassroots level more precisely than before through nonsectoral grants to districts.

The NAADS program responds to agricultural service needs at a much lower community level in farmers' groups. NAADS is able to deliver a higher percentage of allocated resources much closer to the target communities with lower overheads (15%) than before.

Other policy instruments that will further increase impacts from technology investments are being developed to synchronize with on-going programs under PMA and in other ministries. These new initiatives and instruments must however conform to operational principles that are consistent with policies for liberalization, privatization, and decentralization. The new initiatives must also have pro-poor emphasis and be oriented to the market if they are to benefit the poor significantly. The program approaches developed within Uganda's development framework are therefore transferable to other countries in Africa if institutional arrangements that are consistent with well-crafted policies can be established. Often the evasion of policy implementation is at the point of making the required institutional arrangements needed to implement them. Perhaps the most difficult policies are related to genuine liberalization and decentralization. These have had an irreversible impact in the economic, political, and development landscape in Uganda.

Positioning Uganda for Growth and Development

Uganda needs to sustain current economic gains by generating more productivity-led growth especially in agriculture. There is a need for a more comprehensive policy that maintains a balance between tradable commodities and food crops. Agriculture must be strongly linked to agro-industries from the rural level to urban centers. The process of adding value to agricultural produce is Uganda's overriding priority. It is here that intensifying agricultural labor use by introducing machinery and technology will have the biggest payoffs and contribute to driving the modernization of agriculture.

Japanese Commitment for the Green Revolution in Sub-Saharan Africa

Katsumi Hirano

African Economies and Agriculture

From 1980 to 2000, the average annual growth rate of aggregate African GDP was 2.19 percent.[1] Because the average annual rate of population growth during these two decades was 2.82 percent, the change in per capita GDP of Africa was –0.61 percent per year. By contrast, in the same period, the annual growth of GDP per capita was 3.64 percent in India and 8.61 percent in China. India and China tend to dominate the average figures for developing countries due to their large populations and production figures. As a result, Africa has increasingly fallen behind the average growth of developing countries.

Ricardian Trap

While Africa's economic performance has deteriorated, its form of food production has changed from the 1980s. Figure 1 shows the cultivated area and labor input[2] for cereal production in Africa. The land area for cereal production expanded rapidly after the early 1980s, and reached 80 million hectares in the mid-1990s. A 135 percent increase in cereal production in Africa from 1961 to 2000 was brought about mainly by the increasing land input; however, it could not keep pace with population growth (table 1). The productivity of cereal-producing land in Africa grew 0.86 percent a year from 1961 to 2000 and only at 0.09 percent a year after 1980.

Cereal yield in Africa is extremely low. In 2000 it was 1.1 t/ha (1.0 t/ha if South Africa is excluded), compared with 3.2 t/ha in developing Asia and 2.9 t/ha in Latin America. The world average in 2000 was 3.1 t/ha. The gaps in cereal yields between Africa and other regions have been enlarged through the differences in the rates of land productivity improvements (fig. 2).

Considering that the rapid enhancement of agricultural productivity with modern technology paves the way for "industrial revolution" and then sustainable development, as indicated by economic history and neoclassical economics, it can be said that the African economy is still in the pre-industrial revolution age.

As shown in figure 3, the land productivity for cereals in Africa has been growing slowly and at a diminishing rate, while the expansion of land input has accelerated. This extensive pattern is completely opposite to the intensive development observed for Asian cereal production (fig. 4). The development pattern of African food production fits the idea in classical economics that economic growth will be restricted by land constraints, or what is known as a "Ricardian Trap." On the other hand, the Asian pattern conforms to the neoclassical idea that agricultural productivity should increase with technical input to attain an optimal growth path.

As shown in figure 5, cereal production

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Table 1. Increase in cereal production and related parameters, 1960–2000 (%).

	Cereal production	Population	Labor input	Land input	Land productivity
Sub-Saharan Africa	135	188	168	69	39
excluding South Africa	142	192	176	82	33
Developing Asia	211	116	64	12	177
Latin America & Caribbean	191	131	0	30	124

Table 2. Coefficients of the regressions on cereal yield.

	Sub-Saharan Africa		Developing Asia		Zimbabwe		China	
	Lag variable	Time trend	Lag variable	Time trend	Lag variable	Time trend	Lag variable	Time trend
	0.718	0.008	0.995	0.027	0.037	0.004	0.982	0.034
	(6.55)	(7.95)	(83.06)	(51.25)	(0.23)	(0.85)	(55.75)	(29.22)
R^2	0.531	0.618	0.995	0.985	0.001	0.018	0.988	0.956

Note: Lag variable is b in $Y_t = a + bY_{t-1}$, time trend is b' in $LN(Y_t) = a' + b't$, and Y_t is the cereal yield per unit area in t year. t-value is in parentheses.

per farmer in Africa has decreased as a result of the pattern of extensive development. Land productivity ceased to improve, and then total production stagnated, approaching a stationary state in the late 1990s.

In the Ricardian Trap, the African economy stopped growing as well (fig. 6). The poverty problem in Africa was left to become more serious year by year as population pressure intensified.

Unstable Production

In addition to its extensive form of cereal production, African agriculture is also characterized by instability. Figure 7 shows yearly changes of cereal yields in developing Asia and Africa. The violent fluctuations in Africa stand in great contrast to the stable growth in Asia.

The results of the regressions in table 2 indicate that, generally, in China and in Asia the following year's production level can be anticipated with high probability either from the current level or from a time trend, but that in Zimbabwe it is almost impossible to make such predictions.

Significant fluctuations and instability of production make a business risky, therefore agriculture is a quite risky business in Africa. Accordingly, the investment decisions of farmers are depressed and land productivity can hardly be expected to increase. Farmers will prefer to diversify their incomes as insurance, at the sacrifice of specialization in agriculture. Because these behaviors are quite rational, the vicious circle cannot be removed without external intervention.

Expanding Food Imports

In the absence of intensive development, the cereal production sector is supposed to absorb nearly 50 percent of the total labor force in Africa, and its labor input volume is still increasing.[3] It is estimated that the labor input for cereal grew at an annual average

[1] Based on 41 countries for which GDP time series are available for this period (World Bank 1996–2002a; 1992–2000b; IMF 1996–2002). Those countries account for 99 percent of total GDP in Africa and 95 percent of its total population.

[2] Labor input was estimated from the formula [economically active population in agriculture] x [cereal production area / arable and permanent crop area], based on the assumption that the amount of labor input by crop is roughly proportional to the land area assigned to each crop.

[3] This does not necessarily mean that the number of full-time cereal producers is growing, but that many people have embarked on food cereal production in addition to their own businesses. While intercropping, including for food crops, was historically prevalent over the continent, fieldwork and many studies have found that food cereal production expanded as a survival strategy in the economic plight after the 1980s. It took various forms including a shortening of the cycle of shifting cultivation, expansion to marginal lands, and "urban agriculture." (For examples, see: Cromwell 1992; Ikeno 1996; Shimada 1996; Yoshida 1999.)

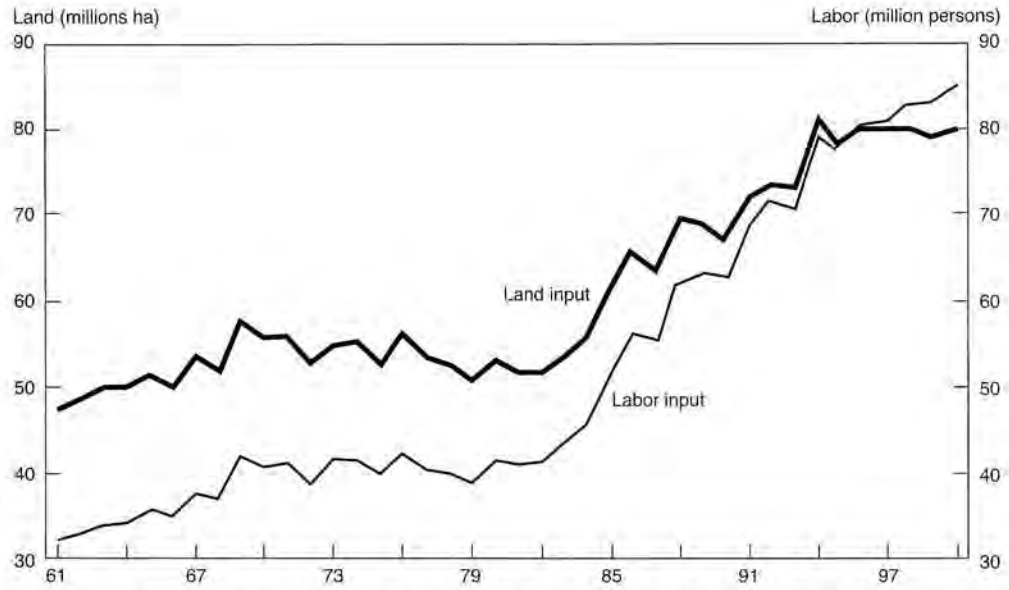

Fig. 1. Inputs of land and labor for cereal production in sub-Saharan Africa. Source: Faostat 2002.

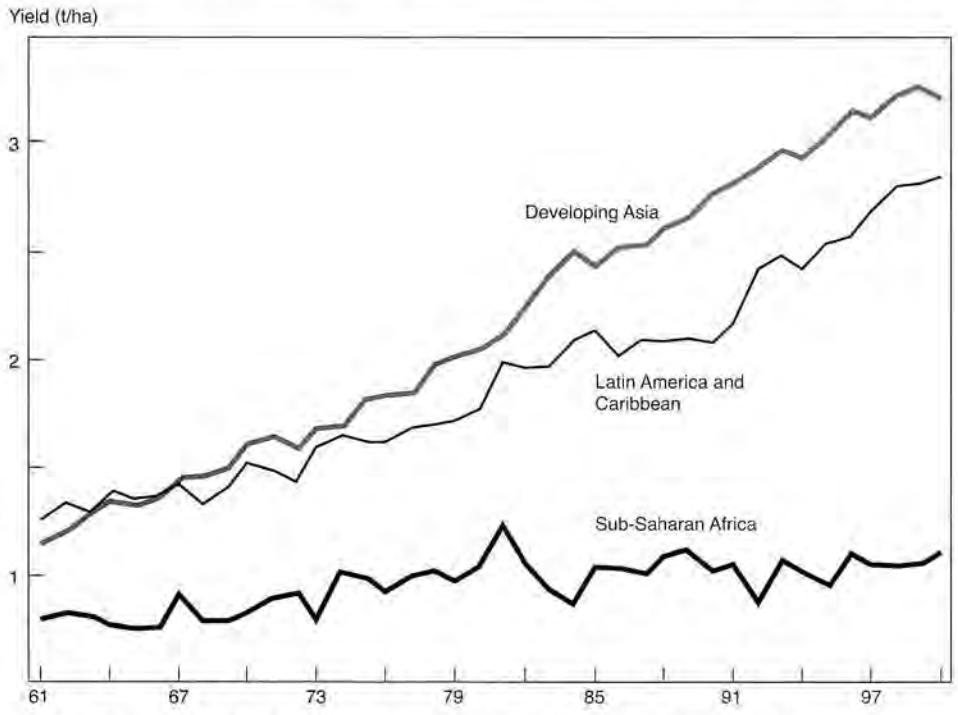

Fig. 2. Land productivity of cereal production (1961–2000). Source: Faostat 2002.

rate of 4.19 percent from 1980 to 2000, but Africa has nevertheless fallen into food deficiency.

Figure 8 shows Africa's cereal imports by volume and as a percentage of domestic supply. Africa has been a net importer since the late 1970s, and the volume has expanded rapidly; it now exceeds that of China. Cereal imports in the drought periods of 1983-84 and 1992-93 were enormous, but Africa's

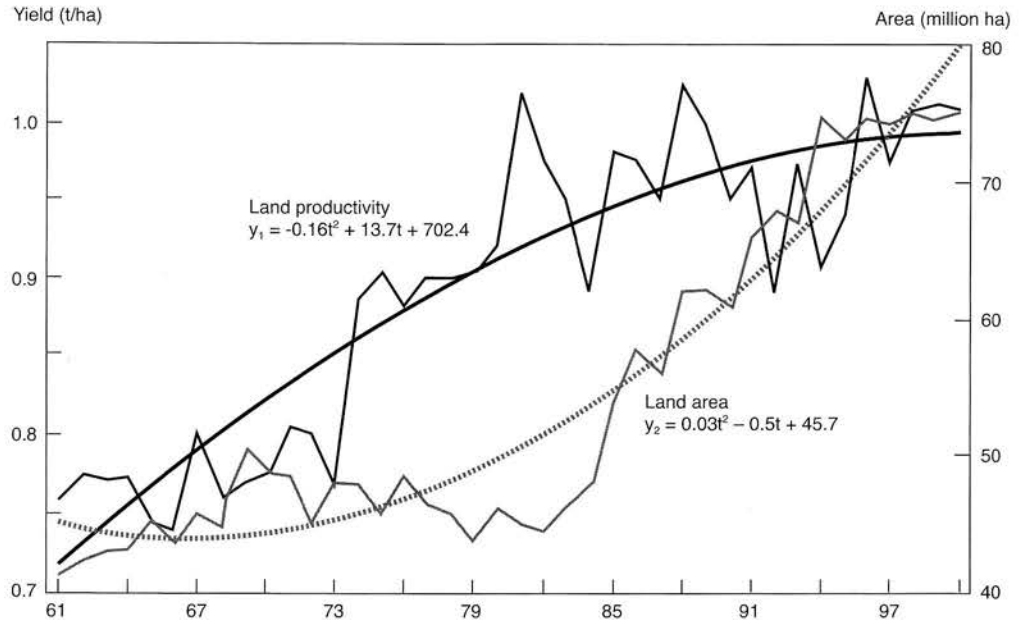

Fig. 3. Land productivity and area of the cereal production in sub–Saharan Africa. Source: Faostat 2002.

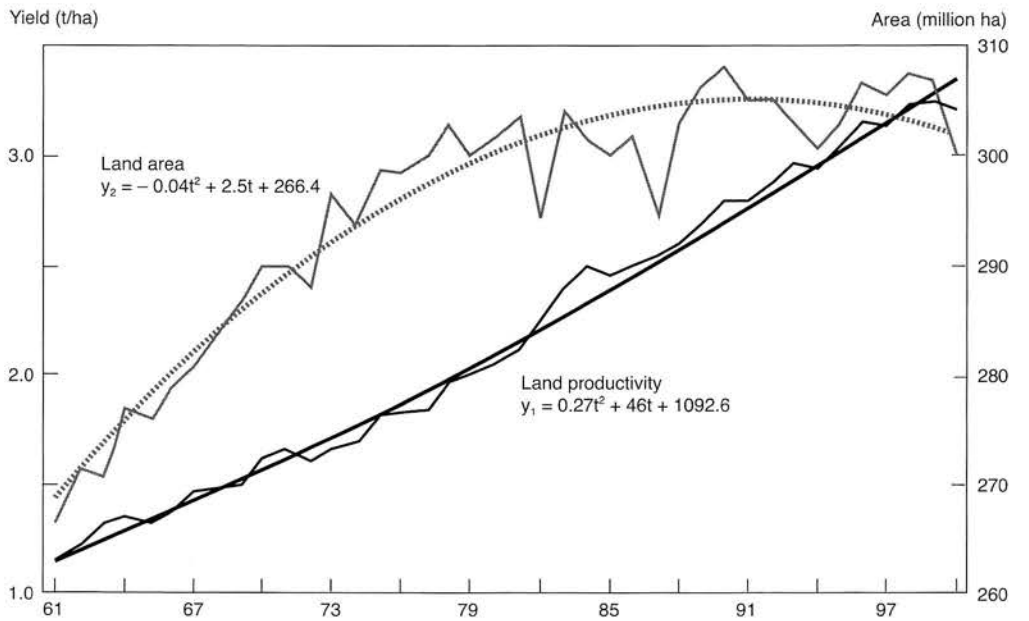

Fig. 4. Land productivity and area of the cereal production in developing Asia. Source: Faostat 2002.

food deficiency must be recognized as a chronic structural problem of the African economy. Even in 1997, when there was normal rainfall in general, the cereal deficiency was 17 kilograms per capita (19 kg/ha excluding South Africa), nearly 10 times the Chinese figure. For Africa as a whole the cereal trade deficit is equivalent to 1 percent of total GDP; the value of the deficit is 9 percent of GDP in Eritrea and 10 percent in

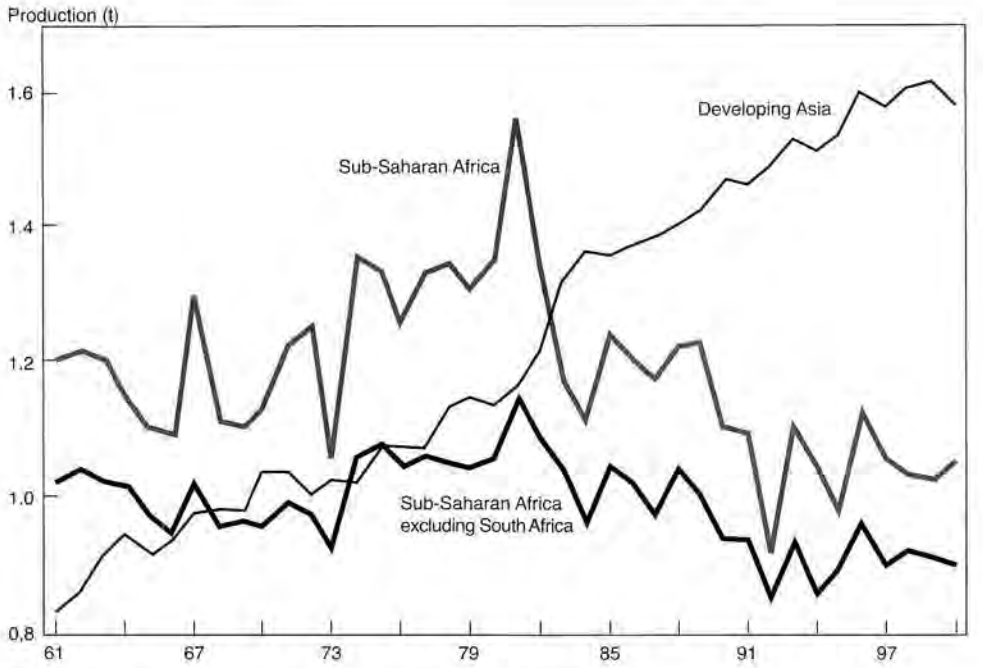

Fig. 5. Cereal production per farmer. Source: Faostat 2002.

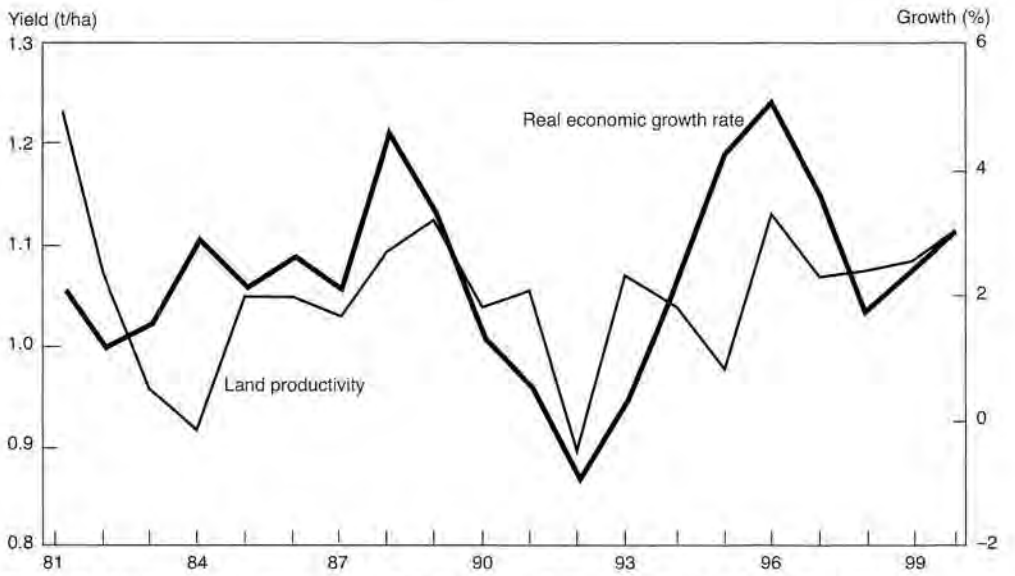

Fig. 6. Real economic growth rate and the land productivity of cereals in sub-Saharan Africa. Source: World Bank 1996–2002a, 1992–2000b; IMF 1996–2002; EIU 2002; Faostat 2002.

Sierra Leone. Based on current cereal yields, Africa would not be able to attain the world average per capita cereal production of 358 kilograms (1997) even if every African gave up his or her occupation and engaged in cereal production. The only hope lies in proper intervention to improve the productivity of the land.

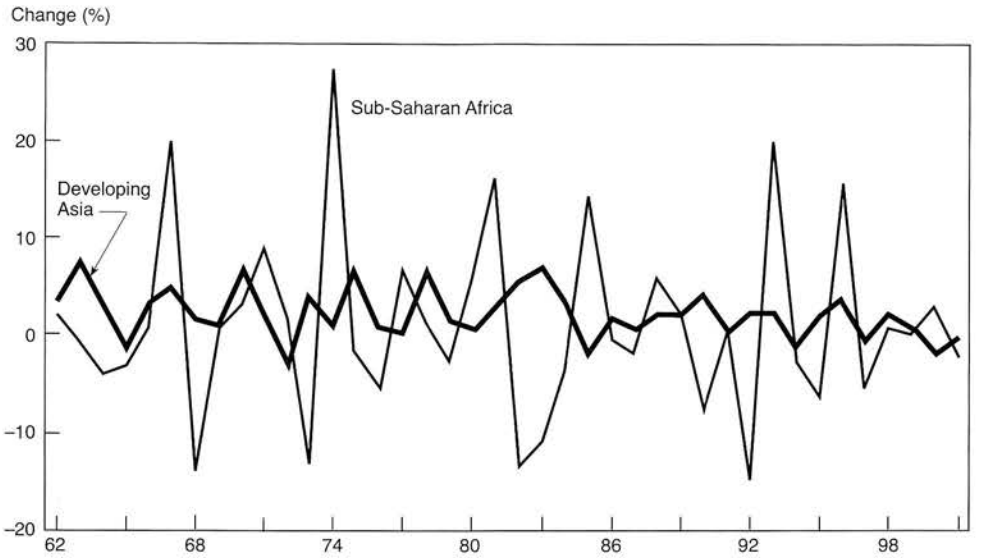

Fig. 7. Changes in cereal yield in developing Asia and sub-Saharan Africa. Source: Faostat 2002.

The Agricultural Revolution and Extension Services

The potential of the African economy is severely constrained by its limited capacity for food production. Subsistence farmers, who make up the majority of Africans, remain in poverty even in high-growth countries like Botswana.[4] Fundamentally, the poor economic performances and serious poverty in Africa can be attributed to the extensive form of food production, i.e., the low-input, low-yield agriculture.

The Japanese Experience

Before the modern agricultural revolution all developed countries had extensive agriculture like that seen in Africa today as did the developing countries of Asia and Latin America before the green revolution. Figure 9 shows real economic growth and rice yields in Japan since 1885. With paddy rice cultivation, a relatively good climate, and fertile soil, Japan achieved 2 t/ha in the 19th century, but the average annual improvement in rice yields was only 0.81 percent before the Second World War. This rate is comparable to the slow growth of cereal yields in Africa, which averaged 0.86 percent a year from 1960 to 2000. However, rice yields in Japan grew rapidly to 6 t/ha during the high-growth period that lasted for almost two decades from the late 1950s to the early 1970s (marked by a rectangle in fig. 9). During those years, the average annual rate of improvement of the rice yield was 2.48 percent, which compared to yield growth rates in other Asian countries during the green revolution. The double-digit growth rates in the Japanese economy were made possible in the meantime by the intensive development of food production, based on the fast and steady progress in the land productivity of staple foods.

As a result, the share of agricultural employment in the total labor force decreased from over 60 percent in the 19th century to 9.4 percent in 1980, and the urbanization of Japanese society proceeded

[4] Between 1980 and 2000, Botswana recorded one of the world's highest economic growths rates, 8.99 percent a year. Forty-six percent of its GDP comes from the mineral sector, sustained by diamonds, which employs just 0.9 percent of total labor; 45 percent of the people make their livelihood through agriculture. The cereal yield in Botswana is as low as the African average and is unstable. The Gini coefficient of the country was 63.0 in 1993 (World Bank 2003a), which indicates that Botswana suffers one of the most unequal income distribution in the world.

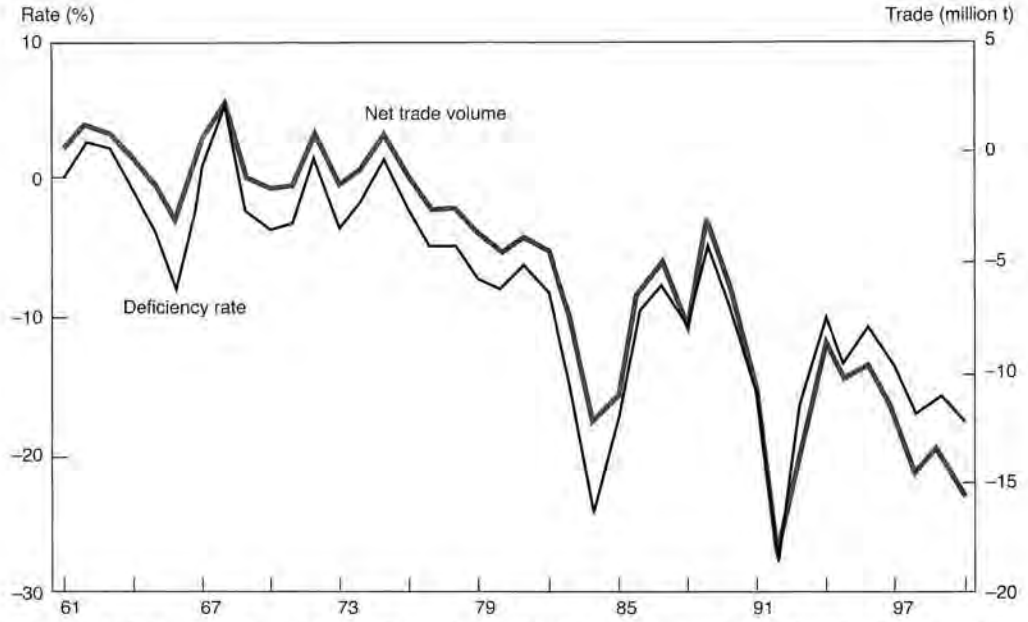

Fig. 8. Sub-Saharan Africa: Tonnage of cereal trade (negative values are imports) and deficiency rate (trade as a percentage of domestic supply). Source: Faostat 2002.

rapidly, with a large number of workers moving from rural districts to be employed in emerging industries. At the same time, the improvements in agricultural productivity allowed farmers' incomes to keep up with their counterparts in the manufacturing sector. And the income distribution among industries and between urban and rural areas was improved.

The government played a pivotal role in the modern agricultural revolution in Japan. Deliberate policies to increase rice production using technological innovation were instituted in the 1880s, soon after the Meiji Restoration. However, it was in the 1930s that a nationwide network of agricultural research institutes and extension system was completed in the public sector (Tanaka 1998). The movement of peasants, which had forced the government to recognize the need to improve their living standards, largely promoted this process. By the end of the 1930s, 14,000 extension workers were serving 6 million farms, attaining national coverage, and improved varieties had reached more than 30 percent of the total cultivated area, replacing traditional ones (Kiyokawa 1995). Figure 10 shows the diffusion of improved rice varieties in Aomori prefecture before the Second World War, as an example.

After the end of the war, these improved varieties were themselves quickly replaced by new varieties, exemplified by the Norin series, which were developed in the national research institutes. The rapid diffusion of modern varieties that had cold-resistance in the northern parts of Japan was the most impressive part of this wave, and it transformed those districts into granaries. While the land reform and the democratization of the social system under the foreign occupation in the immediate postwar years definitely promoted further progress in Japan's agricultural revolution, the well-established extension system built by the new government played an indispensable role in diffusing the new varieties and technologies at the grassroots level. A total of 1,586 diffusion stations were established, covering all rural districts and keeping the number of farms served to 500 per extension worker.

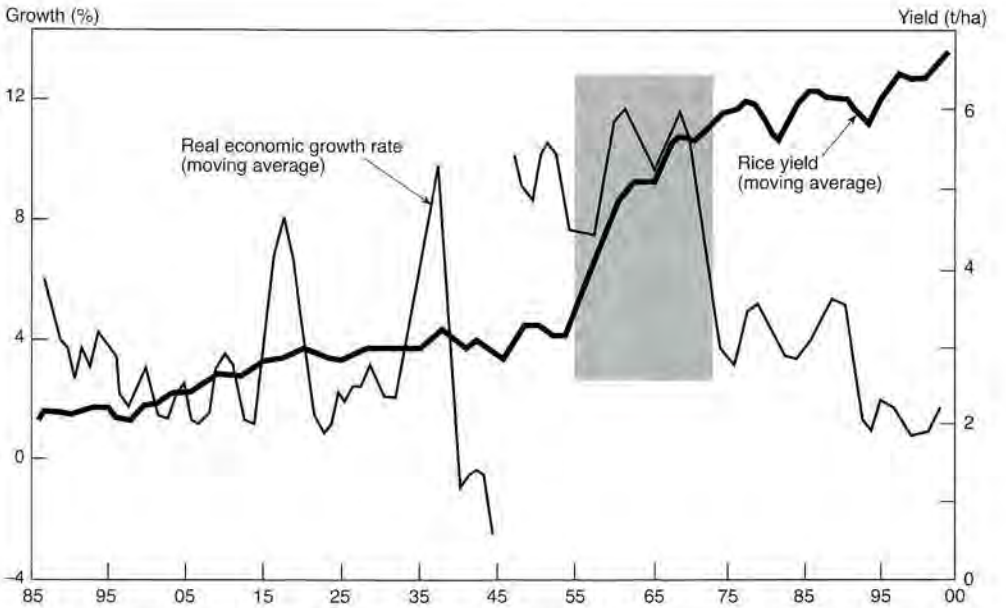

Fig. 9. Real economic growth and rice yield in Japan, 1885–2000. Source: Statistics Bureau 1988, 1997; IDE 1969; Bank of Japan 2002.

These efforts were accompanied by infrastructure-building. The accelerated development of manufacturing is a well-known part of Japanese history after the Second World War, but even greater public investment was poured into the agriculture. On average, from 1955 to 1975, 49.2 percent of industrial development expenditures from the national budget were spent on agriculture, forestry, and fishery far exceeding the 18.0 percent for manufacturing and mining and the 11.2 percent for transportation and communications (Statistics Bureau 1988).

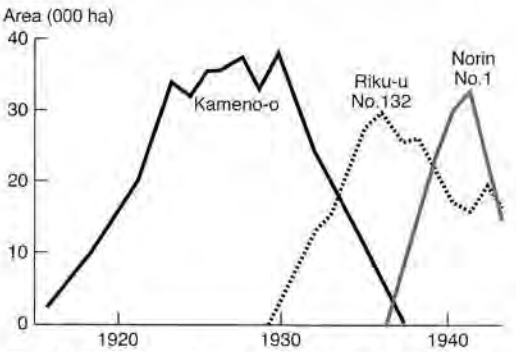

Fig. 10. Diffusion of improved rice varieties in Aomori, Japan. Source: Kiyokawa 1995.

Extension Service as a Public Good

The importance of the public sector in bringing about a modern agricultural revolution can be verified in countries other than Japan. In modern agriculture, technologies are developed in national centers and diffused to production sites, instead of being inherited from former generations. This radical transformation requires huge costs and institutions, which cannot be financed by the private sector nor spontaneously created by the market mechanism. The extension system by its very nature—intentional diffusion using public money—never targets the perfect-information state that would be a prerequisite for the market mechanism.

In fact, all developed countries have created their own routes to agricultural modernization. In the United Kingdom, the pioneer of the modern agricultural revolution, facilities for agricultural research and extension were privately initiated as with the industrial revolution, but were later nationalized under the central government. In Germany, the pioneer in establishing

public apparatuses for the agricultural revolution, agricultural schools under state governments function as centers for technological development and extension. The German style was imported into the United States, where a dual federal-state system was built. Land-grant universities in each state function as centers of research and extension (Ruttan 2001). In developing countries, in addition to the inputs from the colonial era, full-scale extension systems were created in the central governments after the Second World War with assistance from donors. China independently developed an agricultural research and extension system and succeeded in creating hybrid rice varieties in the 1970s. These varieties became pivotal components of the agricultural revolution there (Tajima 1989).

Public intervention is essential for agricultural revolutions. Its functions range widely, from the development of agricultural science to creating extension systems, building infrastructure, securing agricultural inputs, and arranging agricultural finance, etc. Among them, extension services have a special significance as human contacts carried out to channel profitable technologies to the grassroots. Such services can contribute greatly to development with equity, and they do not neglect peasants in remote areas.

Green Revolution in Africa?

Africa has seen little intensive development in agriculture and is severely lacking in food production capacity. In very recent years, although the adoption rate of modern cereal varieties has increased,[5] the expected impact on productivity has not yet materialized (fig. 2). More than half of the modern varieties introduced to African fields resulted from crossing local varieties with others created in international agricultural research institutes (Evenson 2002). Therefore, it can be said that African farmers will become connected to the global community through the diffusion of modern varieties. Such connections must be strengthened before food production in Africa can begin to grow.

Diffusion Model

A number of empirical works on modern agricultural technology diffusion in African countries, such as Adesina and Zinnah 1993, Adesina and Baidu-Forson 1995, Adugna 1997, Mbata 1997, Negatu and Parikh 1999, Doss and Morris 2001, and Ndjeunga and Bantilan 2002, indicate that there are several determinants of farmers' adoption. These studies employed the Probit model (or Tobit model) to measure influences on the adoption of modern varieties or chemical fertilizers. They looked at a number of factors, such as frequency of contact with extension services, characteristics of the individual farmer, and locality, and found that the extension variable was one of the strongest influences.

Diffusion theory in economics has progressed from the classical one, which said that new products would be adopted at a speed determined by their profitability on a time-axis-shaping logistic curve, to the current Probit approach, which analyzes various determinants of adoption. The latter implies that the adoption rate will rise if the determinants are improved. With regard to locality, for example, if unstable rainfall prevents farmers from adopting modern varieties, adoption will take place as irrigation schemes are deployed. And with regard to the characteristics of farmers, if their knowledge level influences adoption, expansion of extension services will raise the adoption rate. Accordingly, the diffusion of modern technologies will accelerate as energetic policy efforts are made to improve farmers' situations.

The current rate of adoption of modern technologies will be explained by various factors, but, the dynamics of diffusion

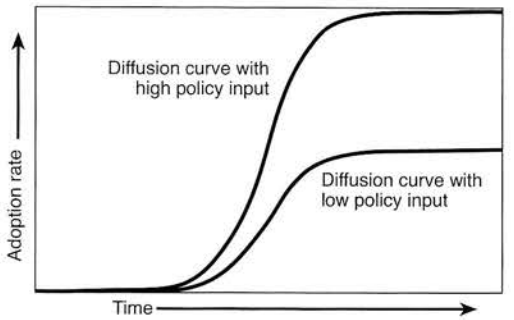

Fig. 11. Diffusion curve.

should be measured over time (fig. 11). Therefore, some determinants explored by Probit analysis can be translated into "variables" that will change with policy input. In the unfavorable situations of African rural areas, policy efforts are needed to accelerate the diffusion of high-yield varieties, and those policies must be given the highest priority on the list of development issues.

Nerica Varieties and Japanese Commitment

In 1994, the West Africa Rice Development Association finally succeeded in an effort to hybridize Asian rice (*Oryza sativa*) and African rice (*Oryza glaberima*). The newly created varieties were given the name Nerica (New Rice for Africa). Nerica varieties are reported to combine the best characteristics of both parents: a high and stable yield (as high as 2.5 t/ha at low levels of input use and 5 t/ha with a minimum increase in fertilizer use), early maturity (90–100 days), drought tolerance, resistance to diseases, responsiveness to mineral fertilization, high protein content, and a taste and aroma favored by local people (WARDA 2001).[6]

In Africa, eight countries produce rice as a major crop: Comoros, Côte d'Ivoire, Guinea, Guinea-Bissau, Madagascar, Mauritania, Liberia, and Sierra Leone. In addition, Mali, Nigeria, Chad, Senegal, Tanzania, Ghana, and Gambia produce more than 10 kilograms of rice per person. However, no country is self-sufficient, and more than 30 percent of total rice consumption is imported. In 2000, 6.6 million tonnes were imported at a cost of over US$1 billion. Africa is overwhelmingly the biggest rice importer in the world. Its import volume exceeds the export capacity of Thailand.

Nerica varieties began to diffuse in West Africa in 1996, and they are now produced in Côte d'Ivoire, Ghana, Guinea, and Togo under the supervision of national extension agencies and an international NGO involved in extension, namely Sasakawa-Global 2000 in Guinea.

The Japanese government has a strong desire to diffuse Nerica varieties for alleviating poverty in Africa. Japan and the United Nations Development Programme (UNDP) established the Africa/Asia Joint Research on Interspecific Hybridization between African and Asian Rice Species project in 1996 as a collaboration of a wide range of national and international organizations.[7] In 2002, an international consortium was created to coordinate wide dissemination of Nerica varieties.[8] When Japanese Prime Minister Koizumi made a commitment for

[5] According to the International Maize and Wheat Improvement Center, the maize-growing area planted to modern varieties in Sub-Saharan Africa reached 46.7% in 1997 (Pingali 2001; also see Evenson 2002).

[6] There is room for further scientific verification and improvement of the performance of Nerica varieties. Especially for Nerica 1 to Nerica 7, which are already cultivated by African farmers, their actual performance in farmers' fields still has to be carefully confirmed.

[7] University of Tokyo, Japan International Research Center for Agricultural Sciences, Institut de Recherche pour le Développement, Centre de Coopération Internationale en Recherche Agronomique pour le Développement, International Rice Research Institute, International Center for Tropical Agriculture, Cornell University, Yunnan Academy of Agricultural Sciences, and agricultural research institutes in West African countries.

[8] The Nerica Consortium is composed of national agricultural research and extension organizations in participating African countries, Japan, UNDP, the World Bank, the African Development Bank, the Rockefeller Foundation, USAID, and NGOs including Sasakawa Global 2000 (WARDA 2002).

agricultural development in Africa, called "Green Innovation," at the World Summit of Sustainable Development held at Johannesburg in 2002, Nerica varieties were central to it.

Aside from Japanese institutions' interest in Nerica varieties, the Foundation for Advanced Studies on International Development and the National Graduate Institute for Policy Studies in Japan have embarked on the research project in Kenya, Uganda, and Ethiopia. The ultimate aim of that project is to ignite a green revolution in Africa based on the Asian experiences.

A decade after the Tokyo International Conference on African Development was initiated in 1994, and almost 20 years after the start of Sasakawa-Global 2000, the perception that agriculture must come first for developmental issue in Africa has been gaining ground among the Japanese public.

Conclusion

To vitalize the African economy and alleviate poverty, subsistence farmers must be the main targets of development policy and development cooperation. Extension services are the most reliable, and almost the only apparatus that can reach them. Extension services reduce the barriers of "imperfect information" to farmers and can lower transaction costs if they assist in the delivery of needed inputs. Farmers will be largely rescued from high-risk circumstances through the technologies that these services bring in.

It is not impossible to overcome the unfavorable conditions in African agriculture, but it will require international cooperation utilizing proper technologies. This requirement stems from the reality of African rural communities. Japanese commitment for agricultural development in Africa will be strengthened further along the lines of the Tokyo International Conference on African Development initiative.

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Plant Genetic Resources: The Basis for Sustainable Agriculture in Africa

Kwesi Atta-Krah

Plant genetic resources are the biological basis of the world's food security and directly or indirectly support the livelihoods of every person on earth. They consist of the diversity of genetic material contained in traditional varieties and modern cultivars grown by farmers as well as crop wild relatives and other wild plant species. They are the raw materials used in producing new cultivars—either through traditional plant breeding or through more sophisticated biotechnology applications. Whether used directly by farmers as a raw material or by plant breeders, plant genetic resources are a reservoir of genetic adaptability that acts as a buffer against potentially harmful environmental and economic change.

Most Africans depend directly on agriculture and natural resources (including plant genetic resources) for their sustenance. Over the years, a vast array of agricultural systems has evolved, ranging from nomadic and transhumant livestock production to intensive smallholder mixed crop–livestock systems.

Although only about 6 percent of Africa's land is cultivated, the agricultural sector accounts for about 35 percent of the continent's GDP, 40 percent of the exports, and 70 percent of the employment. Commercial agriculture is generally important, but agriculture is predominantly small-scale subsistence, or near subsistence, farming.

Africa's Endowment with Plant Genetic Resources

Africa has given the world some of its major crops. Of the 150 food crops consumed by man, 115 are indigenous African species. The world's major regions of crop diversity include the Ethiopian highlands, the Sahelian transition zone, the delta of the Niger River, and the humid forest zone of West and Central Africa. The highlands of Ethiopia are a center of origin for coffee and a center of diversity for sorghum, lentils, wheat, and barley (Harlan 1971; 1976). Tropical West Africa is a center of origin and diversity for African rice (*Oryza glaberrima*), oil palm, yams, and cowpeas. There is considerable interspecific and intraspecific diversity of crop, herbaceous, and forestry species in Africa. Those species that contribute significantly to subsistence agricultural requirements, at least locally, include 5 cereals, 4 legumes, 3 cucurbits, 5 oilseeds, 12 vegetables, 4 roots and tubers, and 5 to 10 fruits. Introduced crops like maize, rice, cassava, beans, and cacao also contribute significantly to African agriculture, and some have developed secondary centers of diversity on the continent. In addition to the widespread staple crops, there are many species that are very important in relatively restricted geographic areas. Among these are teff, fonio, bambara groundnut, and some other minor millets as well as vegetables, fruit trees, and medicinal plants (IPGRI 2001). As for for-

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ages, some estimates suggest that there are a minimum of 63,000 species of higher plants in Africa, and about 3,500 species play major roles in feeding livestock and wild herbivores. African forage species contribute 70 to 75 percent of grasses and 25 to 30 percent of legumes to the world fodder and pasture gene pool, playing particularly important roles in Latin America and Australia.

Endemism—the proportion of species not found anywhere else in the world—is high in Africa. For example, the level of endemism is 69 percent in Madagascar, 38 percent in Mauritius, 68 percent in Cape Province in South Africa, and 11 percent in Tanzania. Other countries in Africa that have high levels of endemism include Sao Tome and Principe in the islands; Côte d'Ivoire, Liberia, Nigeria, Cameroon, and Gabon in the lowland rainforests; eastern Congo, western Uganda, and Rwanda in the montane forests; and Kenya and Tanzania in the coastal areas. In the arid areas, major centers of endemism include Somalia, Ethiopia, and Namibia (Stuart and Adams 1990). Species endemic to Africa include millet (*Pennisetum* spp.), sorghum (*Sorghum* spp.), cowpea (*Vigna unguiculata*), voandzou (*Vigna subterranea*), African rice (*Oryza glaberrima*), fonio (*Digitaria exilis*), and yams (*Dioscorea* spp.). Such endemic species have specific genetic constitutions that confer resistance to diseases and pests, the ability to produce in marginal soils, and resistance to some environmental hazards or stresses like drought. These species are also consumption preferences (e.g., culinary qualities) of the population, and they probably hold the key to food security and sustainable development in the region.

Economic Importance of Plant Genetic Resources in Africa

Considering the value of plant genetic resources, conservation should not be limited to particular genes and genotypes but also should encompass variability or diversity per se, both interspecific and intraspecific. Genetic diversity is the basis for plant breeding and crop selection, and therefore needs to be maintained. It helps in risk reduction while optimizing the potential for responding to diverse situations and end-uses at both the macroeconomic and microeconomic levels. It is also important for adaptation to climatic and economic changes over time. Plant genetic diversity, both at intraspecific and interspecific levels, is therefore an integral part of farming systems.

Plant diversity also provides the essential raw materials for biotechnology, which of late has proved to be important not only in relation to yields but also to the nutritional value of a wide range of crops. The basic building blocks of biotechnology are genetic resources in the form of genes, genotypes, gene complexes, plants, and crops and their varieties. Some of the benefits resulting from biotechnology are better weed and insect control, higher productivity and nutritional qualities, and more flexible crop management. These benefits accrue primarily to farmers and agribusiness, but economic benefits also accrue to consumers when food production is maintained at low prices. Here are some examples of the economic potential of genetic resources in Africa:

1. A single Ethiopian barley plant happened to have the one gene that now protects California's US$160 million annual barley crop from yellow dwarf virus, which to barley plants means death (Witt 1985).

2. Zerazera sorghums from Ethiopia have provided resistance to downy mildew in many inbred lines widely used in United States and Mexico (FAO 1998).

3. In Africa and India, cassava yields have been increased up to 18-fold with disease resistance provided by genes from wild Brazilian cassava (FAO 1998).

4. In their work on interspecific hybridization of rice, Jones et al. (1996) found in

Oryza glaberrima high resistance to *Meloidogyne graminicola*, the nematode species causing the most significant damage to rice in West Africa. *O. glaberrima* is found only in sub-Saharan Africa; the accession in which the nematode resistance was found had originally been collected from Botswana.

5. Through embryo rescue, a gene (Xa-21) for bacterial resistance has been transferred from *O. longistaminata* into rice (Khush 1990). The gene confers resistance to all six races of bacterial blight in Philippines.

In addition, a wide range of wild species including roots and tubers, leafy vegetables, and fruits provides ready sources of high nutritional values for poor households and contributes significantly to health.

Most of these underutilized plants provide a significant proportion of total household income, particularly where farming is marginal. For instance, in Tanzania in 1988, Kiss (1990) calculated that for rural communities the value of wild plant resources, whether for subsistence consumption or sale, was more than US$120 million, or about 8 percent of the GDP. The countries of West and Central Africa have identified a large number of underutilized species that are important to the livelihoods of local populations. These include cereals (7 species), legumes (8), roots and tubers (4), oil crops (8), fruits and nuts (31), vegetables and spices (17), beverages (4), medicinal plants (38), and 44 genera of forages (FAO 1998). Many of these species have a great potential for wider cultivation and, with sufficient research and development investment, could become major crops.

In addition, both governments and the scientific and medical communities have become more aware of the importance of medicinal plants in healthcare systems in Africa. The resurgence of interest in ethnomedicine, ethno-botany, and ethno-pharmacology has resulted in the intensification of field studies stimulated not only by intellectual curiosity but also by the realization that the plant kingdom represents a vast emporium of untapped medical potentialities. Recent discoveries of unbelievably potent and effective properties in plants—the so-called wonder drugs of the past 40 to 50 years—have convinced humanity that we are undoubtedly neglecting life-saving or health-promoting constituents lurking in the many kinds of plant tissues in our ambient vegetation.

The potential for high economic returns from ethno-botanical investigations lies primarily in tropical regions, within which a large section of Africa lies (Ayensu 1978). WWF (1993) estimates that the turnover of pharmaceutical trade in Western Europe in 1989 was US$65 million compared with US$2.2 billion for plant-based medicines, and about 25 percent of all pharmaceutical drugs dispensed in the United States contain one or more substances of plant origin. An enormous number of these medicinal plants are found in Africa. For example, among the flora of Ghana are 754 medicinal plant species used by the local people; the flora of Congo has 51 genera with 160 medicinal plant species. It is now possible to extract many new therapeutic substances from 260 plant species found in Haut-Zaire (now Orientale Province) (Irvine 1961; INEAC 1963; Printz and Heke 1986).

Many African countries are reaping benefits from the production and sale of plant extracts in both domestic and international markets. In Namibia, for example, about 11 companies are known to export *Harpagophytum* sp., and its harvest has become an important source of revenue for local communities. Retail price levels in western markets are as high as US$180/kg (Marshall 1998). South Africa exports approximately 700 tonnes of *Aloe ferox* per year to Europe, Asia, and North America. It is estimated that in 1992 alone, South Africa made US$1 million from the sales of a wild

species of aloe, and over 200 people were employed as aloe tappers (IUCN 1993). The size of the international market for medicinal plants is believed to be considerable, with an estimated trade value in 1995 of at least US$128 million. This demand has promoted additional economic activity and made an substantial contribution to job creation, with several hundred thousand people directly employed in the industry (Mander, Hines, and Mander 1996).

Genetic Erosion

The genetic base of Africa's plant diversity has been eroded at an accelerating pace throughout the 20th century in parallel with the demands of an increasing population and greater competition for natural resources. The main cause of genetic erosion in crops, as reported by almost all country signatories to the global plan of action on plant genetic resources[1] (FAO 1998), is the replacement of local varieties by improved or exotic varieties and species. Other causes include:

1. Rapid expansion of intensive industrial production in which growers cultivate relatively few crop varieties in monocultures.

2. Globalization of the food system and marketing, and the extension of intellectual property systems, which has led to the widespread cultivation of fewer varieties for a more uniform, less diverse but more competitive global market.

3. Land degradation—as lands become eroded, deforested, or salinized, the genetic resources they support are destroyed.

4. Climate change, which poses a threat to diversity because many plants are unable to cope with or adapt to changing temperatures and moisture gradients.

5. Breakdown of traditional systems of natural resource management with the parallel loss of local plant varieties and associated cultural knowledge.

6. Components of agricultural development policies, including the displacement of traditional plant varieties by improved ones (ITDG 2001a, 2001b).

7. Natural disasters, including droughts, floods, and pests and diseases, which have led to widespread losses of diversity in both farmers' fields and natural habitats, e.g., the cassava mosaic virus attack in Uganda.

8. Political instability and civil unrest, which have led to loss of genetic resources in fields as farmers flee war-torn areas and as ex situ conservation facilities are destroyed, e.g., Burundi, Rwanda, and Somalia.

Need for Conservation of Plant Genetic Resources

The importance of conserving threatened genetic resources is becoming widely recognized. The impetus for conservation has been inspired by recent global initiatives such as the Convention on Biological Diversity, the United Nations Conference on Environment and Development, and the global plan of action on plant genetic resources. Traditionally, conservation of genetic resources has primarily been through ex situ conservation (King and Roberts 1980; Ford-Lloyd and Jackson 1981; de Langhe 1984), the conservation of genetic resources outside their natural habitat. Increasingly, however, this method is considered inadequate, due to different characteristics and limitations of the various gene pools and to greater and more diversified user demands and requirements. The Convention on Biological Diversity and the global plan of action on plant genetic resources specifically call for both in situ and ex situ conservation measures for biodiversity and genetic resources conservation (UNEP 1992; FAO 1996). The decision on the choice of conservation methods is not

[1] Formally: Global Plan of Action for the Conservation and Sustainable Utilization of Plant Genetic Resources for Food and Agriculture.

merely a matter of available technology and resources. It is also influenced by biological, economic, management, socioeconomic, cultural, and political considerations (Astley 1992; Frankel and Soulé 1981).

A careful, complementary conservation approach that combines both in situ and ex situ conservation methods will not only achieve this objective but will also lower the risk of germplasm losses that may result from the shortcomings and inadequacies of any one conservation method. It may be necessary to use integrated strategies within one form of conservation method—for example a combination of different ex situ conservation methods such as field gene banks, in vitro techniques, seed banks, etc. Genetic diversity can therefore only be safeguarded through the use of diverse strategies because no single strategy can be relied on to adequately conserve what it took so many human cultures, farming systems, and environments so long to produce.

Policy Framework for Plant Genetic Resources

As the value of genetic resources has become better appreciated, the policy framework governing the access to, benefit sharing from, and intellectual property rights of genetic resources has changed dramatically. Two decades ago, plant genetic resources were considered to belong to humanity, with no particular issues of ownership or intellectual property. During this period, crop improvement was mainly through conventional breeding, and countries readily exchanged genetic materials for research and other uses. It was during this era that FAO established the International Undertaking for Plant Genetic Resources for Food and Agriculture.

Genetic resources have now grown to take on a much larger value. Countries are more conscious of guarding their genetic resources and seek to maximize the benefits they derive from them. Advances in biotechnology and genetic engineering have created a new frontier in agriculture and crop improvement. Huge benefits are emerging from single genes obtained from particular species of crops, and there is now stronger private-sector involvement through biotechnology. National sovereignty over genetic resources has become a major issue. Access to genetic resources in no longer free and straightforward. Issues of intellectual property rights, plant variety protection, and patenting are dominating the policy and legislative debates on plant genetic resources.

The keystone of the FAO Global System on Plant Genetic Resources has been the International Undertaking on Plant Genetic Resources for Food and Agriculture. It was adopted by a resolution of the 1983 FAO Conference and interpreted and complemented by three further FAO Conference resolutions in 1989 and 1991. The undertaking was the first comprehensive international agreement dealing with plant genetic resources for food and agriculture. One hundred and thirteen countries have adhered to the undertaking, which seeks to "ensure that plant genetic resources of economic and/or social interest, particularly for agriculture, will be explored, preserved, evaluated, and made available for plant breeding and scientific purposes."

In 1992, Agenda 21 called for strengthening the FAO Global System on Plant Genetic Resources and its adjustment in line with the outcome of negotiations on the Convention on Biological Diversity. In 1993, the FAO Conference accordingly requested FAO to provide a forum in the FAO Commission on Genetic Resources for Food and Agriculture to allow governments to negotiate:

- revision of the International Undertaking on Plant Genetic Resources, in harmony with the Convention on Biological Diversity
- access to plant genetic resources, includ-

ing ex situ collections not addressed by the Convention on Biological Diversity
- the issue of the realization of farmers' rights

The negotiations for the revision of the International Undertaking on Plant Genetic Resources for Food and Agriculture started in 1994. They continued until 2001, when the 31st FAO Conference adopted the International Treaty on Plant Genetic Resources for Food and Agriculture by unanimity (with two abstentions: the United States and Japan). The treaty is seen as being at the crossroads between agriculture, trade, and the environment. It provides agriculture with a new, legally binding instrument on a par with trade and environmental instruments, and it promotes harmony and synergy across the sectors. It covers all plant genetic resources relevant to food and agriculture. Its objectives are the conservation and sustainable use of plant genetic resources and the fair and equitable benefits arising out of their use, in harmony with the Convention on Biological Diversity, for sustainable agriculture and food security. It aims to ensure that the inherited capital they represent is conserved and continues to supply the flow of services on which food security and development depend.

The International Treaty on Plant Genetic Resources for Food and Agriculture establishes a multilateral system of access and benefit sharing for plant genetic resources, for an agreed list of crops, established on the basis of interdependence and food security. The list currently covers 35 food crops and 29 forage genera, representing more than 80 percent of the world's calorie intake. The genetic resources of these crops are pooled. The country of origin cannot therefore be the basis of benefit sharing, which means that the benefits must also be shared on a multilateral basis, rather than on a bilateral basis.

The treaty provides for benefit sharing through information exchange, technology transfer, and capacity building, and the mandatory sharing of the monetary and other benefits of the commercialization of products incorporating material accessed from the multilateral system. The primary focus is on farmers in the developing world, who conserve and sustainably utilize plant genetic resources for food and agriculture.

It includes a strategy to mobilize funding for priority activities, plans, and programs, in particular in developing countries and countries with economies in transition, taking into account the global plan of action on plant genetic resources, adopted in 1996.

The treaty provides for the realization of farmers' rights by national governments through:
- protection of relevant traditional knowledge
- equitable participation in sharing benefits derived from the use of plant genetic resources for food and agriculture
- participation in national decision-making related to their conservation and sustainable use

The treaty will enter into force after ratification by 40 countries when a governing body, composed of all contracting parties to the treaty, will be convened. Until then, the FAO Commission on Genetic Resources for Food and Agriculture will act as the interim committee for the treaty and will oversee tasks undertaken in the interim period.

The International Treaty on Plant Genetic Resources for Food and Agriculture will then supersede the International Undertaking on Plant Genetic Resources for Food and Agriculture, including in relation to the ex situ collections of plant genetic resources for food and agriculture held in trust by the research centers of the Consultative Group on International Agricultural Research. Until then, the undertaking, under the aegis of the FAO Commission on Genetic Resources for Food and Agriculture, is the governing agreement.

With the adoption of the International Treaty on Plant Genetic Resources for Food and Agriculture, a new door of opportunity has now opened for facilitating access, benefit sharing, and the overall conservation and use of plant genetic resources. African countries need support through capacity-building initiatives to accelerate their ratification of the treaty and to strengthen their implementation of the terms of the treaty.

Conclusion

Plant genetic resources, and indeed the diversity within these resources, are fundamental elements that influence the stability and sustainability of agriculture and the environment. Genetic diversity is also the basis of food security. The food security that we enjoy today is a result of the plant genetic resources conservation efforts of yesteryear. Future increases in agricultural productivity and crop yields, whether through conventional breeding or through biotechnological approaches, will be based on the plant genetic resources available in the field and under conservation systems.

It is commonly accepted that genetic erosion is occurring at an alarming rate within agriculture and also within forests. Some species are extinct and a number of others are under threat of extinction. The genetic base of Africa's plant diversity is therefore being narrowed, largely as a result of a multiplicity of environmental, political, and socioeconomic factors. Serious efforts must be made to ensure that this trend is halted and that plant genetic resources are adequately conserved and used in addressing humanity's present and future needs. African countries need to implement complementary conservation approaches to safeguard their plant genetic resources.

On-farm and in situ conservation deserves much more emphasis and support. The activities of communities in the conservation and use of genetic resources need to be acknowledged, and benefit-sharing mechanisms should be established to support the efforts of farmers and communities in conserving genetic resources.

Policy frameworks have been established at international and regional levels to guide and facilitate issues of access, ownership, and benefit-sharing in relation to plant genetic resources for food and agriculture. Within countries, there is however a proliferation of groups and associations that are active in various international policy conventions and negotiations but are uncoordinated. Within individual nations, cooperation is needed to:

- harmonize approaches to implementing international agreements and other national or regional priorities
- coordinate common approaches to participating in international meetings and negotiations
- develop country-specific capacity-building approaches to these issues
- strengthen capacity development in the area of plant genetic resources policy and legislation
- take advantage of each entity's comparative strengths and individual successes and failures

NEPAD offers a framework within which genetic resources conservation and sustainable use could be promoted, in line with the recommendations of the Convention on Agricultural Biodiversity, the FAO global plan of action on plant genetic resources, and the recently adopted International Treaty on Plant Genetic Resources for Food and Agriculture. Some programmatic areas on plant genetic resources that could be incorporated into the agriculture and environment agendas of NEPAD are:

1. Conduct a regional plant genetic resources assessment and foresight. This activity can be done in collaboration with the FAO global plan of action on plant genetic resources.

2. Capacity building to improve Africa's participation in international negotiations and to domesticate the International Treaty on Plant Genetic Resources for Food and Agriculture.

3. Strengthening national and subregional plant genetic resources programs.

4. Creating sustainable financing for plant genetic resources activities in the continent.

The International Plant Genetic Resources Institute seeks partnership with national programs and with international institutions in the promotion and technical implementation of conservation activities in Africa. This work should be done in partnership with the Forum on Agricultural Research in Africa and NEPAD.

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Adaptation and Use of International Best Practices in African Agricultural Services

A. M. Foster and S. Nahdy

The continuing failure of agriculture in sub-Saharan Africa to keep up with food consumption has prompted much hand-wringing and subsequently a search for alternatives to traditional publicly funded and expedited research and extension services. In comparing the agricultural progress of Africa and Asia, it is generally accepted that Africa's macroeconomic policies, underfunding of research and extension, ineffective funding mechanisms, and limitations of the biophysical environment present different sets and scales of challenges.

Nevertheless, there is also consensus that although research and extension systems in sub-Saharan Africa and Asia received comparable funding, the impact on productivity in Africa has been small compared with what was achieved by the Asian green revolution. Donors and beneficiaries have been short-changed. Some may contend however that this is not a justified expectation, given the very different circumstances between the two continents.

The search for the best practices suited to African smallholders has left a trail of projects, programs, and institutions in the public and private sectors that collectively describe a range of approaches to research-extension-farmer links. These programs have varied in institutional arrangements, mechanisms of funding, methodologies, and goals (table 1). What lessons can we draw from them? And how should the lessons influence approaches to technology innovation and dissemination for smallholders in sub-Saharan Africa?

Research-Extension-Farmer Information Systems

The analysis of the case studies that follow assumes that agricultural information provided through extension services is for the most part a public good. As such, it is not excludable and "nontrivial," that is, anyone can consume it, and one person consuming it does not diminish its availability to others. This is because smallholder farmers need only basic information to improve their productivity. However it is also true that with increasing specialization, extension services can also supply information as a private good. Such information affects solely the person consuming it. A good example is the case for information geared toward specialized producer associations. Clearly, the information provided to smallholders has a mix of public and private good characteristics. In general the public good attributes are dominant at early stages of agricultural development. As agriculture develops, agricultural information becomes more specialized, less easily shared, and not universally consumable. In this form, it is more of a private good. Where producers

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Table 1. Best practices of agricultural technology innovation and dissemination in Africa.

Information Channel	Advantages	Disadvantages	Current Status
1. Traditional Public-Sector System			
a) Publicly funded and delivered R&E services, e.g., Ethiopia	Focus on farmer training as a public good. Large pool of extension staff available to NGOs. Emphasis on commodity crops.	Lack of specificity of information available. Underfunded, monolithic, and bureaucratic. Generally not cost-effective nor sustainable. Weak linkage to research and marketing.	Outmoded but still in use in many African countries.
b) Modification of traditional publicly funded and delivered services (late T&V, VLPA)	Focused attention on helping smallholders. Increased capacity of extension system for a while. Extensive national coverage. More participatory in later stages.	Top-down, regimented messages—assumed linear R-E-F linkage. Weak technical content. Weak link to marketing. Operated in stand-alone project mode. Trapped in myth of methodology. Could not meet raised expectations.	Terminated experimentation with T&V.
2. Private Extension Services			
a) By commercial firms that provide extension to promote their interests, e.g., SAR, Mexico	Focused on single commodity crops or special objective as agenda. Provides services, inputs, technical information, and markets to producer associations.	Farmers' interests not paramount. Narrow focus and less scope for training farmers. Bias toward product. Moral hazard.	Exists in fewer places and cases—tobacco, cotton, etc. Transforming into producer associations with more general services.
b) NGO & projects: form of private extension service –Early SAA intervention. –Bilateral projects	Broaden scope of training for farmers to include aspects of rural development. More effective in reaching target groups due to closer supervision of hired public extension staff. Other crosscutting issues can be considered.	Have own agenda that may be inconsistent with farmers' long-term interests. Stand-alone projects with no institutional framework —sustainability weak. Biases toward favored areas or market driven.	Effort to move toward common basket funding, if reforms are successful. NGOs to be co-implementers at field level, if they have capacity.
3. Public/Private Partnerships			
a) Publicly funded, privately delivered, e.g., NAADS – contracting of services Uganda, Mexico, Zimbabwe	Demand-driven and farmer-empowering. More diagnostic and less prescriptive. Increased effectiveness and efficiency. Increased coverage and decentralized to reach more farmers.	Requires institutional reform process. Need to build capacity of service providers. Need to envision longer term intervention and support. Need to bridge credibility gap between public and private staff.	Currently in vogue, but should be tailored to specific country situations; must be led by fundamental reform process aimed at pro-poor economic development.
b) Public-private-(NGO) New joint initiatives: –GOU-WB-SG 2000 –AATI (Rockefeller) –RETF (DFID)	Opportunity for power of partnerships to strengthen relevance and ownership of service delivery and to build sustainability, e.g., one-stop center approach.	Need to devise new ways of working with farmers—learning approach. Need to learn the role of institutional arrangements in shaping new paradigms.	Frontier of search for alternatives— need to recast NGO approaches in line with contracting and institutional roles in accordance with reform process. Maximize synergies to exploit comparative advantages in multiple partnerships: government-donors-NGOs-rural communities.

Note: T&V = Training and visit system; VLPA = Village-level participatory approach; R&E = research and extension; R-E-F = research, extension, farmer; SAR = Societal Agricultural Regales; SAA = Sasakawa Africa Association; NAADS = National Agricultural Advisory Services; GOU = Government of Uganda; WB = World Bank; AATI = African Agricultural Technology Initiative; RETF = Rural Enterprise Technology Facility; DFID = Department for International Development (UK).

pay to obtain such information, it becomes proprietary and may be protected as a private good, permanently if possible. The relative merits and disadvantages associated with various types of research-extension-farmer information channels are outlined in table 1.

The dominant perception in Africa is that research and extension systems communicate information to farmers through a linear research-extension-farmer linkage that feeds back to research. This assembly-line logic has shaped past and current technology innovation and dissemination systems. A new perception of technology innovation and dissemination as a more integrated, dynamic, and iterative learning process is emerging in response to reforms intended to increase the efficiency and effectiveness of research and extension systems. A chronological review of the information channels that have been used in Africa reveals three main types (table 1). There are many variations within each category, but for the sake of brevity we consider here the advantages, disadvantages, challenges, and conditions that are generally associated with the main types.

Traditional Public Extension System

The traditional publicly funded and delivered research and extension systems that emerged after the colonial period typically employed between 8,000 and 20,000 extension workers in the national ministries of agriculture. As governments became poorer, the extension systems were ineffective because there were insufficient funds for operations after paying staff salaries. The performance of these extension systems was poor because they had weak links with research and marketing institutions. These traditional extension systems focused on cash crops, which determined their relationship with farmers as supervisors of production progress.

Early attempts to increase the effectiveness of traditional extension systems centered on methodological approaches like the training-and-visit system, the village-level participatory approach, on-farm-research, and client-oriented research. None of these methodologies proved to be a panacea for overcoming low agricultural productivity, and much still ails the traditional extension approach in many African countries. Similar low levels of performance for the traditional extension approach have been reported in Latin American countries during early stages of their development. Van Crowder (1991) reported low levels of performance of extension staff and a tendency to appropriate some of the benefits intended for farmers because of poor salaries and general working conditions. In some African countries, it is not unusual to find that extension workers are less food secure than the farmers they are supposed to be helping to achieve food security.

These monolithic extension systems continue to exist in a variety of forms depending on the degree to which macroeconomic reforms, civil service reform, and functional analysis of ministries of agriculture have forced them to change. Tanzania, Ghana, and Uganda once employed over 10,000 extension workers each, but the staff sizes have now been lowered to a few thousand workers, and in Uganda to just a few hundred. By contrast, in Ethiopia some 15,000 extension staff continue to serve within the national extension service.

Private Extension Systems

The emergence or existence of private extension systems in a country may be taken as a sign of the upward mobility of farmers who require specialized services that they can afford to pay for. Typically commercial firms or marketing firms promote their

interests for particular commodities or products through a network of privately employed agents that render services to producer associations. NGOs that use government extension agents to pursue their agenda also fall into the category of private extension services to their target groups even though the motive may not be a direct financial benefit. NGOs invariably pay top-up salaries or meet operational expenses that constitute a form of remuneration for extension staff and are an incentive for them to work harder or pay special attention to NGO programs.

Private extension systems in most African countries serve few farmers because most farmers in Africa are smallholders who are not organized into associations. Private extension services have had notable impacts in cotton in Mali, tobacco in Zimbabwe and Malawi, vegetables in Kenya, and cut flowers in East Africa.

It is clear that although private extension services are effective, they are too limited in scope to serve the wider body of farmers, especially the poorer farmers. Therefore private extension services will not entirely replace the need for public extension services. Nevertheless the sources of their increased effectiveness such as lower ratios of extension providers to farmers, greater operational mobility, and better educated extension workers are attributes that must be shared with the public extension services. A key component of the greater effectiveness of private extension services has been providing access to production inputs. Even NGOs like SG 2000 and Appropriate Technology have incorporated this practice in their approaches. However the provision of inputs to farmers can only have long-term benefits if it is done in a way that is consistent with the principles for developing competitive private entrepreneurship.

Private extension services commonly are pinpoint operations, that is, they have no nationwide coverage. Even larger undertakings involving government are cast as stand-alone projects that lack any institutional framework, and therefore their sustainability is limited to the lifespan of the projects that spawned them.

NGOs and bilateral programs that focus on the public good aspects of private service provision can improve the impact of private extension systems by helping farmers' associations to broaden their scope of training and involvement in other enterprises.

Danida and SIDA have emphasized such approaches in Zambia and Uganda where they have supported the emergence of farmers' associations from amalgamation of several hundred producer organizations. UNFA in Uganda, however, suffers from having resulted from an externally driven desire to merge groups and to form an apex body. It may be that lower level independent associations have smaller overhead costs and are more responsive to their members.

Public-Private Partnerships

The limitations of private extension services suggest that, realistically, public extension cannot be entirely replaced by private extension. The objective therefore should be to increase the complementarily of the two approaches as a means to increase efficiency and broaden services to farmers. The challenge is to find ways to complement government-funded extension services by involving the private sector (cooperatives, farmers' groups, other community-based organizations, NGOs, and agribusiness operations). This endeavor will require a fundamental reform of institutional roles and processes for promoting agricultural development aimed at smallholder farmers. Such changes should be expected not only within the public sector but also in farmers' institutions, NGOs and, to a lesser extent, agribusiness firms.

Examples of public-private partnerships already exist in industrialized countries (United States, United Kingdom, France) where the private sector is much larger that the public sector. Input suppliers, equipment dealers, and processing firms regularly provide information for public dissemination and conduct research alongside or in conjunction with the public agencies.

In developing countries, especially in Africa, this process is negligible because the private sector has no readily appropriable benefits in smallholder farming, particularly in marginal areas or among the poorest farmers. It can therefore be argued that it is in the public interest to kick-start the process of public-private partnerships to extend services and benefits to smallholder farmers.

Also the spillover effects of private extension activities can be maximized to the benefit of smallholders and poor farmers in more marginal areas, if public extension compliments private extension activities in a constructive manner.

For example in Bolivia, technologies applied to high-value crops grown by farmers' associations spilled over to low-value food drops. In Kenya, use of fertilizer and insecticides designated for contract growers of beans spilled over to maize. Similar experiences were reported for broccoli growers in Guatemala and cotton growers in Mali where inputs and animal traction aimed at members of cooperatives are now available for more general use within the target communities.

Implementing a public-private partnership is clearly a two-stage process. The primary stage is the institutional reform of public extension services that follows a policy decision. The second stage is the realignment of the private sector including NGOs to take advantage of the new opportunity to provide more effective services to smallholders.

The experiences of the National Agricultural Advisory Services (NAADS) program and SG 2000 in Uganda provide useful lessons. The NAADS experience encompasses the reform process from policies through institutional arrangements and funding mechanisms. The SG 2000-Uganda story involves a realignment to fit within the new institutions that emerged. SG 2000's intervention approach had to be reoriented and working tools developed to reach a wider body of farmers with a broader range of technology options and services.

Impact of Reform on Research and Extension Systems

Uganda's Plan for the Modernisation of Agriculture (PMA) called for the poor to participate in generating significant growth in agricultural productivity that would benefit them and contribute to national development. The upshot was that under the PMA, a new multisectoral development framework was designed to promote increases in productivity and the incomes of smallholders. The PMA was housed in the Ministry of Finance to ensure that budgets of the key sectors that interface with agriculture would contribute first and foremost to removing the constraints that impede agricultural productivity at the grassroots level. The PMA also demanded reform of agricultural extension and research to ensure that they were refocused on the stated policy agenda and its principles in their design and mode of operation, sweeping away old institutions and ways of doing business if necessary.

The new paradigm dictated by the PMA illustrates more clearly the dynamics between farm, market, and technology development. This fundamentally deep impact on the development arena has compelled stakeholders to adjust their institutions and programs to stay relevant to the development process.

Reforms are already under way in all seven priority areas of the PMA. National agricultural advisory services have been recast and re-launched, the national agricultural research system reforms are near completion, and reworked policies of food, nutrition, and rural finance are before Parliament. NGOs, community-based organizations, and private service providers are also having to adjust their agendas and programs to fit the new situation.

NAADS Experience

The impact of the PMA was first felt by the national extension system. After completion of the World Bank agricultural extension project in 1998, the extension system was abolished at the national level, and all implementing staff were transferred to districts. As a result, staff of the Ministry of Agriculture fell from over 18,000 to just 287. The PMA secretariat then set up a task force of stakeholders across the full spectrum of society to participate in the design of a national agricultural advisory service (NAADS) that would be demand-driven, client-oriented, and farmer-led and that would also focus on women and the poor as participants, not just as beneficiaries. The reforms resulted in four main changes that in turn sparked a demand for immediate reform of the research system.

First, farmers were transformed from beneficiaries to participants in the formulation and provision of agricultural advisory services. Through the creation of farmers' groups and associations, farmers gained control of resources to address their perceived priorities based on information provided to them about markets, technology development, and returns to investment opportunities by NGOs that were contracted to build capacity of farmers' groups to demand services.

Second, the role and approach of agricultural service providers were redefined so that advisory services were shifted from public delivery to private service providers on a competitive outsourcing basis. The service providers were then by contract accountable to farmers' groups for their performance. The process of raising the numbers of private service providers and improving their performance quality is a work in progress that will involve cooperation with specialized agencies and institutions for technology development such as adaptive research training teams and SG 2000.

Third, the financing of agricultural advisory services was separated from its provision so that delivery of funds is not synonymous with delivery of services. More flexible options for funding also permitted the provision of services to different types of farmers by contracted service providers and the training of service providers themselves to build their capacity. Farmers have an opportunity to contribute to the cost of advisory services incrementally as public financing is gradually withdrawn over 20 years.

Finally, deepening decentralization of services has resulted in the devolution of powers, functions and services under NAADS to the lowest level of government. Subcounties are now receiving designated funds directly from the Ministry of Finance. They also are able to tender contracts for provision of services under the local government bill.

The operationalization of NAADS created demands for a new structure and functions for the national agricultural research system. The proposed reforms aim to increase the efficiency and effectiveness of extension services to smallholder farmers through:

- reorientation and accountability of research to the end users
- opening competition to other potential service providers

- joint stakeholder coordination of the research agenda
- decentralization of research to the district level
- redefinition of a national research agenda to avoid a donor-driven project approach

Impact of Reforms on SG 2000's Intervention

Sasakawa-Global 2000 interventions in Africa aim to promote use of productivity-enhancing technologies that sustainably increase the food security and farm income of subsistence farmers. The SG 2000 project in Uganda began in 1997 after a pilot phase. Initially the SG 2000-Uganda project worked in concert with an agricultural extension program funded by the World Bank. The program used a training-and-visit methodology. The emphasis was on strengthening the technology content of the agricultural extension program, which was largely based on messages. SG 2000 helped introduce demonstration plots that included a spectrum of options for farmers but were not tied to provision of credit, although purchased inputs (seed and fertilizer) were used on demonstration plots. A range of production packages were developed for farming systems associated with maize, sorghum, and coffee/banana systems. Some intervention focused on productivity increases arising from higher economic yields, reduced produce losses, labor, and added value. SG 2000 also undertook a parallel initiative to develop a rural network of private input distributorships based on free-market principles.

By 2002 over 16,000 demonstrations of assorted technologies had been conducted at which more than 84,000 farmers were trained. Thirty percent were women. Seed of more than 12 improved varieties was introduced for seven crops that were involved in demonstrations or seed multiplication to create rural seed banks. Several hundred tons of legumes (beans and groundnuts) were multiplied in farmer-to-farmer seed multiplication programs to complement the cereal production systems involving rotations or intercropping. Live mulches are also being introduced into the perennial cropping systems to reduce erosion and the transfer of organic matter from fields sown to cereals. Over 400 improved animal traction implements were introduced to till more than 2,000 hectares of land every season at 30 percent reduction in labor requirement. Several hundred improved post-harvest storage structures were co-funded for use at homesteads or at marketing facilities by farmers' groups. Agro-processing training was introduced with emphasis on cassava, which is planted as a food security crop and only used in times of crisis. More than 200 small-scale input dealers are now operating in rural areas, selling seed and fertilizer.

In spite of these achievements, national yield levels remain low because the SG 2000 intervention reached less than 5 percent of the 2 million small-scale farm households in Uganda. The constraints are limited resources and an absence of an acceptable mechanism for scaling up without creating an artificial availability of resources or coercing farmers to produce at below-market prices.

After 4 years of implementation, SG 2000 began to address the problem of sustainability and expansion of impact by developing one-stop centers. The one-stop center concept focused on ensuring that farming communities can maintain access to the services SG 2000 had helped extend to smallholders in rural areas. It also provided an opportunity to increase the numbers of users of the services beyond the critical thresholds needed to make the services financially viable. To achieve this, SG 2000 helped consolidate farmers' groups into associations and then helped them to build

minimal infrastructure facilities to support coordination of training and marketing services for the rural communities. Arrangements are under way to expand this pilot scheme in collaboration with other NGOs, development partners, and local governments.

The inception of NAADS in 2002 posed significant challenges for the SG 2000 Uganda program. Although SG 2000 already worked in a very decentralized way with districts and subcounties with Ministry of Agriculture staff, the assignment of service provision to private entities gave farmers a number of choices for their advisory services. SG 2000 was faced with trying to sustain its activities as isolated stand-alone programs or integrating them into the new NAADS framework. SG 2000 chose to reposition itself to co-implement NAADS at the village level and to assess what other needs may arise from that partnership.

In 2001/02, SG 2000 began a pilot program in two districts and three subcounties to help prove the NAADS approach. Several NGOs of varied capacities joined this effort. The experience clearly demonstrated that some NGOs lack the capacity for technical service provision, although many were useful in institutional capacity building. NAADS and SG 2000 have therefore joined up to train service providers at the national level and to help supervise the quality of their work to ensure standards are met. As part of the capacity-building process, NAADS and SG 2000 are also examining ways to replicate the concept of one-stop centers in other areas based on the principles of farmer ownership and management. One-stop centers are a precursor of farmers' institutions that can be contracted to provide services to other farmers. The farmers who have access to a one-stop center have a significant head start on other smallholders who have not yet been reached by extension services.

Several countries have also conducted study tours to assess the possibility of replicating the NAADS program and one-stop centers. SG 2000 and World Bank staff are considering collaborating on a handbook for operating one-stop centers as a rural development tool.

Transferability of the Uganda Extension Model

The challenges of transferring the national agricultural advisory services and one-stop center models to other countries are in some respects similar but on a different scale. Establishing a national agricultural advisory service requires a fundamental reexamination of the purpose of advisory services and an adherence to a long-term program that is underpinned by a learning approach to the multivariate problem of sustainably increasing farmer productivity. A national agricultural advisory service requires a new farmer-centered approach to control the selection of enterprises, the design of appropriate technologies, and the provision of services. Such control should be achieved through funding mechanisms that farmers can control by using their institutional structures. A national agricultural advisory service also demands that donors suspend their various interventions and join in providing support through basket funding. NGOs should also join in co-implementing the national agricultural advisory service instead of running stand-alone projects. The national agricultural advisory service model is free of methodological rigidities because various service providers may use approaches that farmers feel comfortable with. Such methods and approaches must however meet the set standards of service delivery required.

Countries that wish to establish a national agricultural advisory service based on publicly funded and privately delivered services must therefore first consider if they

are willing to put funds at the disposal of farmers and give them control. They must also assess their capacity to devise funding mechanisms that can allocate those funds through farmers' institutions to service providers.

Another issue is whether a government will accept the inevitable downsizing of publicly employed extension advisors in a ministry of agriculture. Retraining many of these civil servants as private service providers is a precondition to downsizing. Many former extension officers will need to convert to private service provider companies if the scheme is to be successful.

A major consideration is creating competent partnerships (like NAADS-SG 2000) that will assist in capacity building and monitoring of service provision. Such specialized partners are needed to ensure that strong links between technical service providers and national research and advisory systems are maintained. Such links will ensure that the best research information goes into formulating solutions to the challenges posed by farmers on a demand-driven basis.

There also need to be mechanisms for farmers and service providers to get current market information. If market information systems do not exist, national advisory services have a responsibility to help build them in collaboration with the appropriate stakeholders.

The major change that needs to be anticipated is broadening the role of advisory services to include cross-cutting rural development issues that affect technology development, such as AIDS/HIV, poverty, and illiteracy. The agricultural sector must make a contribution to the building blocks for development beyond its contribution to production.

The one-stop center approach is a grassroots tool that permits advisory services to directly link technology innovation and dissemination to key external constraints that affect farmers' ability to access and use improved technologies.

NEPAD's Role in Research and Extension Reforms

One avenue for broad-scale intervention through the New Partnership for Africa's Development (NEPAD) is to include aspects of the institutional reforms and arrangements needed to empower farmers in its peer-review mechanism. More focused discussions should be held on how this can be done in view of the specific institutional arrangements that are required for more effective research and extension services. NEPAD should therefore be interested in studies that examine ways of making the institutional reforms more supportive of technology development. NEPAD must also set targets for harmonizing and integrating regional trading blocks. Proactive measures like those for Uganda Grain Traders need to be encouraged more widely to ensure that farmers have access to markets in Africa.

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Soil Fertility Strategies: Setting the Stage

Henk Breman, Kofi Debrah, and Amit Roy

In Africa, agriculture constitutes the backbone of most economies since it provides more than 60 percent of all employment. The agricultural sector, however, has underperformed. Weak food security and enduring pockets of malnutrition are acute problems.

From the early 1960s to the late 1980s, Africa's population grew by about 3 percent a year, while agricultural output rose by only 2 percent a year. As a result per capita food production has declined. Between 1990–92 and 1997–99, per capita dietary energy supply in sub-Saharan Africa expanded slightly from 2,120 to 2,190 kcal/day. Yet, during that period, the number of chronically undernourished people increased from 168 million to 194 million.

Cereal yields in Africa have continued to languish—unlike other regions. In 2001 cereal yields averaged 1.2 t/ha in Africa compared with 3.1 t/ha in Asia, 3.0 t/ha in Latin America, and 5.5 t/ha in the European Union. Latin America and Asia are now almost self-sufficient in cereals, but sub-Saharan Africa has become increasingly dependent on food imports. In 2000, sub-Saharan counties imported about 17 million tonnes of cereals, including 2.8 million tonnes of food aid. Food aid will surely increase in 2002 given pockets of crop failure in southern and eastern Africa.

At sub-Saharan Africa's current rate of agricultural growth, the potential for economic advances is limited (Kabbaj 1997). Sub-Saharan Africa's low agricultural productivity is rooted in the poor natural fertility of the soils, overexploitation of the resource base, and unfavorable socio-economic conditions including inappropriate government policies. This paper analyzes those conditions and proposes strategies for combating food insecurity and increasing agricultural productivity to meet the goals of the New Partnership for Africa's Development.

Particularities of Africa

Low Natural Fertility

The poor natural resource base of African agriculture is an even more limiting factor than the interlinked socioeconomic conditions (Penning de Vries and Djiteye 1982). In Africa 16 percent of all soils are classified as having low nutrient reserves, while in Asia the equivalent figure is only 4 percent. Soils in sub-Saharan Africa are formed from old, weathered rocks that are low in nitrogen and phosphorus, the two

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most important nutrients for healthy plant growth. As a result of the characteristics of the dominant clay minerals, the soils have limited capacity to store nutrients and water, making them prone to erosion.

The climate with its low, irregular, and erratic rainfall regimes further contributes to low soil productivity (Breman 1990). The annual water balance (precipitation minus evaporation) of African soils is estimated at 12.7 centimeters compared with 25.8 in North America, 64.8 in South America, and a world average of 24.9. Consequently, perennial plants in Africa provide less organic matter to the soil than they do in other parts of the world. These conditions make the soils of sub-Saharan Africa inherently low in natural fertility.

Agroecological Conditions and Overexploitation

The deficiencies of African agriculture are evident from comparing cereal yield changes across countries or continents. When cereals are grown under extensive agriculture, without the use of external inputs, average yields increase less than 10 kg/ha annually, while in the green revolution cereal yields increased at about 75 kg/ha annually (Breman 1998). From 1950 to 1980 the average annual cereal yield increases were 10 kg/ha in Africa, 19 kg/ha in South America, and 25 kg/ha in Asia. These growth rates slightly exceed those of Western Europe and the United States before the 1950s, indicating that some of the knowledge and means of production has trickled down from North to South. In South America and Asia, a sharp increase took place after 1980, but in Africa as a whole cereal yields are still increasing at a rate of 10 kg/ha annually (Breman 1998).

The failure of the green revolution to take root in Africa can be partly explained comparing changes in the use of external inputs in Africa, India, and China (CGIAR 2000). In 1960, differences in fertilizer use were small: 5 kg/ha in Africa compared with 10 kg/ha in India and China. Thirty-five years later, fertilizer use had increased by 60 percent in Africa, while in India it increased by 1,100 percent and in China by 2,300 percent. The number of tractors and the amount of land under irrigation followed similar trends—rapid growth in the India and China and very limited growth in Africa.

A comparison of Africa and Asia as a whole also shows large differences in per capita cereal production and per capita fertilizer use. In Asia cereal production per capita increased from 231 kilograms in 1970 to 274 kilograms in 1995, and total fertilizer use per capita (all crops taken together) grew from 0.005 kilograms to 0.019 kilograms. During the same period, cereal production per capita in Africa decreased from 166 to 137 kilograms, while total fertilizer use per capita remained negligible (less than 0.005 kg) (Soh 1998).

Nutrient mining of soils aggravates the situation in Africa. Harvesting, grazing, and wood cutting remove more nutrients from the soil than are returned by natural processes, farmers' practices, and fertilizer. Average use of inorganic fertilizer in Africa is less than 10 kg/ha of nutrients—only one-tenth of the world average. Besides the lowest yields, Africa therefore has the highest soil nutrient depletion rates: a negative annual nutrient balance of about 60 kg/ha (fig. 1).

The situation in West Africa may be the worst of all. As in East and Central Africa, average annual rates of nutrient (NPK) depletion on agricultural land in West Africa are 50 to 100 kg/ha, but the inherent quality of the natural resources is lower. For example, the annual sustainable availability of nitrogen in West Africa is less than 20 kg/ha; only Australia's Northern Territory and Patagonia have a comparably low amount of nitrogen naturally available for sustainable

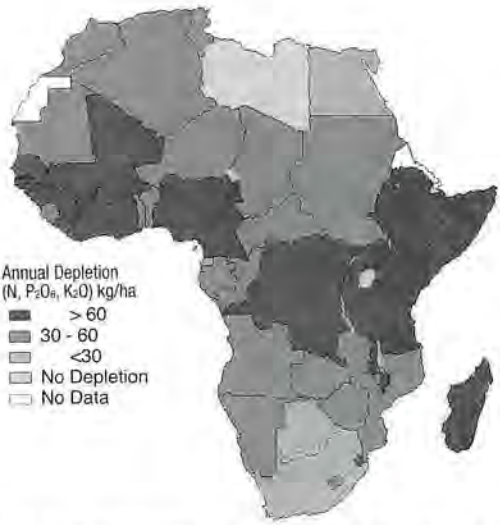

Fig. 1. Average annual nutrient (NPK) depletion in Africa (1996–98). Source: Henao and Baanante 1999.

plant production. And the amount of available phosphorus is so low in Africa that the annual contribution of leguminous species to the available nitrogen is not more than 1 to 3 kg/ha. But Patagonia and Northern Australia are almost empty (one to two persons per square kilometer), while the population density of West Africa is 20 to 40 persons per square kilometer (Breman 1990; Penning de Vries and Djiteye 1982).

To sum up, African agriculture is characterized by a poor resource base, a low level of external input use, and a negative balance of plant nutrients. This overexploitation of a poor resource base is caused by overpopulation within the present socioeconomic context.

Overpopulation as such is not solely a problem, it can also be part of the solution (Tiffen, Mortimore, and Gichuki 1994). However, the resource base of West Africa and of other vast African regions is so poor that overpopulation occurs at low absolute population density. Intensification of agriculture and the use of external inputs are required at a moment when most production is still oriented toward food self-sufficiency and development of infrastructure is limited. For example, much of Africa has less than 10 percent of the road density of India, which has 1,004 kilometers of paved roads per million people. By comparison, Ghana has 494 kilometers of paved roads per million people, Uganda has 94, and Ethiopia has 66.

Such poorly developed infrastructure and other factors make inputs very expensive for farmers. In Lilongwe, Malawi, for example, the price of urea is more than four times the world market price. A significant part of the high cost is attributable to inland transportation and high bank interest rates.

High inputs costs are combined with very low efficiency of inputs, caused by the same unfavorable agroecological conditions (in particular the low nutrient- and water-holding capacity of the soils), by the slow development of domestic markets and purchasing power, and by limited employment outside agriculture (inherent to overpopulation at low absolute population pressure). So, the extremely low use of external inputs and the slow transformation from self-sufficiency to market-oriented production is explained by the low efficiency of agricultural inputs, the high price of inputs at the farm gate, and the low price of agricultural products. To remedy overexploitation through overpopulation, fertilizers and other external inputs must be used, making it essential for farmers to produce for the market in competition with others. However, competitive intensive agriculture is not easily developed in areas of low absolute population density.

Socioeconomic Context

The socioeconomic environment in which African agriculture operates has changed. Prior to the structural adjustment programs of the 1980s, governments were responsible for procuring and distributing agricultural inputs. As a part of structural adjustment,

input markets were abruptly privatized and liberalized with no transition to allow for the emergence and development of the private sector. Regulations to guide privatization were not created, nor were roles for government in the privatized input market identified. Privatization therefore started on a shaky footing in an unpredictable environment for private-sector participation. The basic elements of agricultural market reform were:

- government withdrawal from fertilizer procurement and distribution
- liberalization of input and product markets and prices
- removal of subsidies and guaranteed prices
- ending of pan-territorial and pan-seasonal prices
- abolition of parastatal marketing boards

The state's withdrawal from the market and the liberalization of importation created an opportunity for the private sector to enter the market. Initially, the response of the private sector was encouraging. As privatization progressed, importers and distributors of agricultural inputs proliferated. Parastatal companies and plantations (e.g., cotton, rubber, oil palm, banana, pineapples, cacao) that had been importing fertilizer and other inputs for their producers disengaged from direct importation and resorted to the use of international tenders for the private sector to supply inputs.

For cotton, for example, the annual value of those tenders was several millions of dollars per country. Because of stringent bank requirements for credit (usually 100% guarantee for establishing letters of credit), only suppliers with financial capability or with connections to the manufacturers won the tenders, to the exclusion of the larger number of suppliers that had no access to credit.

Despite this, the market share of government agencies in procurement and distribution began to shrink while the share of the private sector began to rise. Parallel markets emerged, with a segment selling subsidized fertilizer procured and distributed by some NGOs or some commodity-specific subsectors for their clients.

Privatization and market liberalization also gave rise to the proliferation of fertilizer types, often with doubtful qualities in the absence of quality control regulatory systems (Debrah 2000).

Reform policies that cut input subsidies, dissolved parastatal input distribution and extension services, restricted agricultural credit, and liberalized output markets made it difficult for farmers to sustain the use of agricultural inputs they had adopted before the reforms.

The socioeconomic context, both external and internal, continues to undermine efforts to intensify agriculture and make it more sustainable. The external factors include globalization and the WTO agreements. Also policies of developed countries (e.g., dumping and protectionism) impede the development of African agriculture (subsidies to farmers in developed countries total about US$1 billion a day). The internal factors include inadequate, inappropriate, and sometimes inconsistent agricultural policies that discourage private-sector participation and that favor consumers above producers. Moreover, the reforms have been partial, which together with misuse of donor input aid, make it too risky for the private sector to invest in input market development. The picture is not complete without mentioning social unrest and the lack of domestic and international investments. The overall result is that average use of external inputs today is even lower than at the start of structural adjustment.

Causes of Agricultural Stagnation

Exceptions to the general trend among countries, regions, and crops underline the importance of the factors causing stagnation elsewhere and highlight technologies and strategies for change. It is not lack of knowledge about the agroecological environment that threatens the future of rural populations. Indigenous production systems developed in the past allowed optimum exploitation of available resources (Kessler and Ohler 1983). It is no accident that the population pressure is the highest where production conditions are the most favorable. The knowledge and experience of generations made it possible to reach population pressure far exceeding the carrying capacity of the land.

But the consequences become clear during droughts. Soil depletion and overgrazing lead to loss of vegetation, diminishing soil organic matter, and degradation of chemical and physical soil properties. Arable farming progressively expands into crucial dry season rangelands of pastoral systems, and the formerly effective pastoral systems break down.

The situation is not desperate, however. Increasingly, pastoralists become farmer-oriented, and farmers become pastoralist-oriented, keeping more animals. Arable farming is maintained through integration with animal husbandry, and animals are reared for traction and manure and to serve as a form of savings. Crop-livestock integration thus appears to be an effective step to more intensive use of external inputs.

The analysis above, explaining why the green revolution observed in Asia was not repeated in Africa, is supported by exceptions in areas where intensification is becoming a reality. Indeed, successes exist despite structural, economic, and social difficulties. Intensification, based on the use of fertilizers and other external inputs, takes place where the negative effects of poor natural resources are not severe enough to keep farmers from using external inputs. They also take place in areas where the value-cost ratio is favorable enough even without an enabling socioeconomic and policy environment. A good example is peri-urban agriculture, which is flourishing throughout Africa using relatively high dosages of external inputs (Kouvonou, Honfoga, and Debrah 1998). High production levels of vegetables and fruits are attained near cities, and cereal production is intensifying within the perimeter of the peri-urban areas. The driving force is the concentration of people in the urban centers who have relatively high and regular incomes. This condition creates a ready market, leads to an improved transport and distribution infrastructure, and enables soil fertility improvement thanks to the urban wastes turned into compost (Cour and Snrech 1999).

A study of the evolution of agriculture in 14 West, Central, and East African sites shows that population growth, reduction in transport costs, and the growth of markets lead to intensified agriculture (Wiggins 1995). Internal markets and regional markets appear to be even more important stimulants for change than exports of cash crops. In his study, Wiggins excluded strife-torn countries. The steadily growing farm outputs that he observes in most cases are therefore biased. He overlooks another factor—the quality of the resource base for agriculture. In 12 of his 14 sites, the rural population density is higher than the average for the country, the urban population included. The sites are mostly in regions with advantages like relatively good soils or high water availability; several sites are valleys. Therefore, the efficiency of external inputs and the cost-benefit ratios are rather favorable.

This observation is reinforced by annual

fertilizer consumption patterns for African countries (Henao and Baanante 1999). Three regions exist where fertilizer use is above the African average of less than 10 kg/ha of nutrients: North Africa, the West African cotton-producing countries, and a band of countries from Eritrea to South Africa. Besides the influence of nearby European markets, the more temperate climate of Northern Africa and the fertile Nile valley favor the use of external inputs. The West African cotton belt has adequate rainfall conditions and rather reasonable soils. The eastern and southern African countries are characterized by highlands, creating a relatively temperate climate, while more recent volcanic activities corrected in a certain sense the old leached and weathered soils. Even in those three regions, average fertilizer consumption remains low, generally less than 20 kg/ha of nutrients. Egypt is the exception with rates of more than 300 kg/ha; South Africa and Zimbabwe use about 50 kg/ha. Certainly, commercial farmers use most of the fertilizer, but smallholders use several times the African average. Thus averages mask crucial differences within countries as well as among crops.

Cotton in Mali and Burkina Faso, for example, receives more than 100 kg/ha of nutrients, while cereal production remains mostly extensive. Again, the detailed picture is different. Just as smallholders in southern Africa benefit from the availability of fertilizer because of the large commercial farmers, maize production in the West African cotton belt shows a much higher yield increase than sorghum and millet elsewhere in the concerned countries.

Rice in West Africa also illustrates the point (Defoer et al. 2002). From 1984 to 1999, rainfed upland rice production increased by 27 percent entirely as a result of expansion of area. Rainfed lowland rice production increased by 200 percent and irrigated rice production by 170 percent, both in part through yield increase. In 1984, the yield of rainfed upland rice, without external inputs, was 1 t/ha, and the yields of rainfed lowland and irrigated lowland rice were 1.4 t/ha, showing that the more favorable soil and water conditions of the last two production systems. Only the rainfed lowland and irrigated systems have since been intensified; yields in 1999 were 1.8 and 2.1 t/ha, respectively.

An example of the influence of socio-economic factors comes from the Office du Niger, a parastatal in Mali. Important investment projects supported by the Dutch, the French, and the World Bank did not succeed in increasing the productivity of irrigated rice: yields remained at about 1.5 t/ha, the average since Mali's independence. But privatization and liberalization of input and output markets triggered change. It became attractive for farmers to invest in inputs and in more labor-intensive technologies. In 10 years, yields increased to 5 t/ha. To obtain such yields, farmers go beyond the recommended fertilizer doses of 175 kg/ha.

In conclusion, intensification takes place and improved technologies are adopted where at least some of the following conditions are present:

- relatively favorable climates
- relatively good soils (e.g., good storage capacity for nutrients and water)
- irrigation systems, which allow efficient use of agricultural inputs
- high population pressure and urbanization
- relatively good transport and distribution systems
- progressive economic and agricultural policies
- access to markets (local, regional, or international)

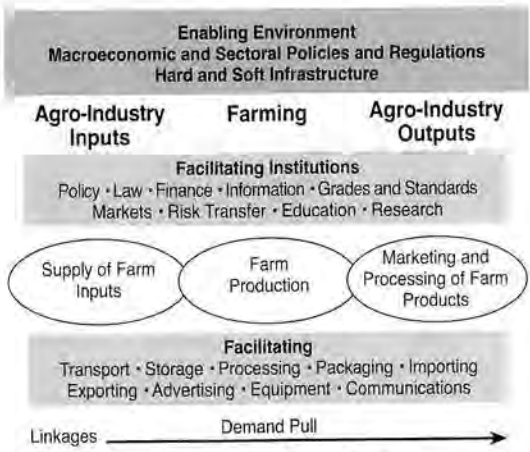

Fig. 2. The agribusiness system.

Opportunities for Change

Through understanding of Africa's agroecology and socioeconomic and policy environments, strategies for change can be formulated. The intermediate goal of such strategies should be improving the value-cost ratios for using external inputs. The agronomic components of a strategy must ensure more efficient use of inputs, and the socioeconomic environment and policies of governments and donors should give farmers incentives to adopt the technologies and foster more remunerative prices. Thus the approach should be more holistic in the context of a total agribusiness system (fig. 2). This system involves manufacturing or procuring off-farm inputs and marketing them to farmers. Farmers in turn use the inputs in farm production systems to enhance agricultural production, productivity, and farm income. The system also involves the sale and value-added sorting, grading, storage, processing, and marketing of food and fiber. Farmers and farm production are at the center of the total system with both vertical and horizontal dynamic linkages and interlocking mechanisms among all the subcomponents and the facilitating services required for each of the subcomponents. The effective demand by end-user markets of agricultural products is the ultimate driving force of all agribusiness systems. Thus for the total system to function effectively, a key component is fertility of the soils.

Integrated Soil Fertility Management

The resource base of African agriculture has to be improved to trigger agricultural intensification through more sustainable production systems. The main options are improving water availability and improving nutrient availability. The first option is in principle very attractive: soils in regions with irrigation potential often have above-average soil fertility, while irrigation in itself decreases the risk of using external inputs. However, Africa is not well endowed with irrigation potential, and even small-scale irrigation systems are expensive. Although irrigation has benefits (e.g., the steadily increasing production of rice in Mali), the value-cost ratios of irrigation infrastructure are low. The investment costs range from US$4,000 to US$8,000 per irrigated hectare. This high cost does not prevent governments and donors from investing in irrigation infrastructure, while neglecting soil fertility, because of the perception that water is the most limiting factor for agricultural development in Africa (Rosegrant and Perez 1997; Seckler, Gollin, and Antoine 1992).

Low soil fertility is more limiting than water, even in the semi-arid Sahel. From the 400 to the 1,200 millimeter rainfall isohyets (the middle of the relatively humid southern Sahel to the transition from Soudanian to Guinea savannah), cereal yield rises from about 0.5 t/ha to 0.8 t/ha. That is, a three-fold increase in water availability is accompanied by only a 60 percent increase in yield. Irrigation at the 400 millimeter isohyet leads to rice yields of 1.4 t/ha and, combined with fertilizer use, 8 t/ha is possible. At 400 millimeters, fertilizer use alone increases the fodder production of natural rangelands from 1.6 t/ha to between 4.8 and 8 t/ha, depending on soil texture (Penning de Vries et al. 1983). The prejudice that water is the main limiting factor appears, however, almost ineradicable. This view is regrettable, considering the limited African irrigation potential, the millions of farmers dependent on rainfed agriculture, and the relatively favorable value-cost ratios of soil improvement and fertilizer use.

The framework for national soil fertility improvement action plans led by IFDC and the World Bank (IFDC 1997) identified soil improvement and fertilizer use as a more general solution for intensifying agriculture in Africa. Chemical fertilizer has a low agronomic efficiency where the agricultural resource base is as poor as it is in most of Africa. Improving the soil's organic matter status, availability of phosphorus, and pH can increase efficiency. Chemical fertilizer itself is often required for this change in order to produce enough organic matter of desirable quality. The integrated use of chemical fertilizer and locally available soil amendments is therefore recommended. The synergism created leads in time to higher fertilizer-use efficiency, i.e., to improving the economic feasibility of its use. Soil improvement is in this context both a tool for and a goal of agriculture intensification based on more sustainable production systems (Breman 1998).

The integrated soil fertility management approach was developed by Dutch-Malian research cooperation and has been perfected by IFDC and its partners. A menu of integrated soil fertility management options has been developed for West Africa, taking farmers interests, agroecological conditions, and the socioeconomic context into account (Breman and Sissoko 1998; IFDC 2002). In this approach, inorganic fertilizers are combined with amendments like crop residues, manure, compost, and phosphate rock; or inorganic fertilizers become elements of complex systems like agroforestry, crop-livestock integration, cereal-legume rotation, and crop-pasture rotation. The medium-term results have been encouraging. Fertilizer-use efficiency values up to twice as high as the regional average have been observed. Yields of maize, sorghum, and millet are typically two or sometimes even three times higher than average levels. Returns to invested capital exceed 100 percent, with value-cost ratios well above 2, and returns to family labor two to six times higher than the average "wage-rate" prevalent in the region (Maatman 2002). It is noteworthy that integrated soil fertility management has a comparative advantage for smallholders and marginal land. Capital is partially replaced by labor and by the adaptation of the production systems to the particularities of the agro-ecosystem.

The investments required for improving soil fertility are considerably lower than those for irrigation. They also differ from those for irrigation in that they are spread over a period during which the soil organic matter and the related benefits build up. Breman (2002) estimated the costs of investing in soil fertility improvement for the West African cotton belt and found a doubling of fertilizer-use efficiency.

Although chemical fertilizers were part of the package, they were regarded as annual production inputs, and therefore their costs were excluded from the estimation. The major investments in soil fertility improvement apart from chemical fertilizers are organic amendments (straw or manure) and erosion control. The latter presumably is required to start improving degraded loamy soils that have a high risk of surface crust formation and excessive run-off (Penning de Vries and Djiteye 1982). Only the erosion control investments must be paid entirely at the start; the rest can be spread over 4 to 7 years. The per-hectare investments costs ranged from US$550 (straw) to US$730 (manure). These are only fractions of the investment costs for small-scale irrigation. The benefits of soil fertility improvement accrue slowly and peak after 4 to 7 years. When fertilizer-use efficiency doubles, the internal rate of return is between 11 and 15 percent, compared with 10 percent or less typically obtained for irrigation investments (Rosegrant and Perez 1997).

Enabling Socioeconomic and Policy Environment

Despite the low investment costs and the favorable value-cost ratios of integrated soil fertility management technologies, their adoption rate is low. The bottlenecks include farmers' lack of capital, the long time required for the direct benefits to be realized, and farmers' poor access to input and output markets. As a result of these constraints, farmers continue to deplete the soil in the short-term because it is a more efficient way for them to maintain their revenues than attempting to change the production system (Sissoko 1998; Hilhorst and Murwira 2000).

Farmers who are degrading natural resources by lack of choice, contributing to desertification and climate change, need support to change their practices. Governments, donors, and international financing institutions should do as much as possible to promote change. IFDC and others have called for creating socio-economic and policy environments that enable farmers to invest in their soils and allow the private sector to invest in developing input and output markets (IFDC 1997; Sissoko 1998; DFID 2002).

Direct investments in soil fertility improvement should be part of the solution. Improving the availability of sources of organic matter is an option for Africa as a whole. Soil amendments like phosphate rock, lime, and gypsum should be promoted, but their use will depend on the regional requirements, the availability and quality of the amendments, and the costs of transport and distribution (Kuyvenhoven, Becht, and Ruben 1998).

Accompanying efforts to improve the fertility of the soil should be measures that address credit problems and land rights, improve and extend rural infrastructure and marketing and distribution networks, facilitate adoption of technologies that enhance yield and reduce production costs, increase the effectiveness of extension services, and change governments' preferences from supporting consumers to supporting producers. Close attention should be given to the availability of external inputs, especially inorganic fertilizers, and farmers' access to them.

Governments must become facilitators instead of actors. This point has been an important conclusion of an analysis of sub-Saharan Africa's failing agricultural input sector (IFDC 2000). Too often a government's role in input accessibility is not transparent and consistent. That is one reason structural adjustment programs, particularly privatization of the input sector, do not seem to have been effective; access to agricultural inputs is declining in Africa.

A closer look at this trend, however,

reveals that fertilizer consumption has continued to grow (less than 1% annually) in almost half the countries of Africa since the 1980s, while in others fertilizer consumption has stagnated or even declined. Our comparison of the evolution of chemical fertilizer consumption during the last 10 years and the World Bank's analysis of structural adjustment successes (World Bank 1994) reveals one positive correlation between fertilizer consumption and degree of structural adjustment reform. In the 12 countries in the World Bank study in which fertilizer prices were subsidized or at least under government price control, the average fertilizer consumption growth rate was only 1 percent, compared with 6 percent for the 17 countries without any control on prices or marketing.

But these averages mask huge variation. The group without price controls includes several countries with negative growth rates, while the group with control over prices includes one country with a growth rate twice as high as the average of the others. External inputs may be cheap when they are acquired through illegal sources (e.g., smuggling) and output markets are available. The replacement of groundnuts by cowpea in Niger during the 1970s seems to be an example. Cowpeas were produced for the Nigerian market using smuggled subsidized Nigerian fertilizer (Breman and Sissoko 1998).

Worldwide, an impressive list of cases proves that input accessibility and use is best served by creating an environment that enables private investment in market development. These experiences led IFDC (2000) to devise a strategic framework for developing private input markets in Africa. Governments have an vital role to play in inputs quality control, input and output market information systems, tax reforms, and regional cooperation where small markets fail to attract private investments. When these services are missing, the private sector cannot grow to its potential.

During the transition period in which governments change from being an actor to a facilitator, farmers' organizations and private input dealer associations must be formed, trained, and strengthened. Farmers' organizations and trade associations will have at least three basic functions: creating economies of scale in input procurement, etc., providing access to credit, and advocacy. As governments pull back, a dialogue among farmers' organizations, private-sector associations, and the public sector becomes indispensable for agricultural development. To be effective, the individual stakeholder groups have to have more or less the same strength, that is, the agricultural development triangle should be balanced (Debrah and Nederlof 2002).

In many countries, fertilizer consumption fell sharply following subsector reforms because the government withdrew abruptly and the private sector was not prepared well enough. To restore consumption of fertilizer to previous levels, some have advocated the use of direct subsidies (Reardon et al. 1998; Sanders, Shapiro, and Ramaswamy 1996). One government is providing subsidized inputs to farmers who are too poor to purchase inputs at market prices or lack the means to acquire credit., Such interventions, however, distort functioning of a competitive market and discourage private investment. Instead, income support such as a voucher scheme could be considered. Each targeted resource-poor farmer would receive a voucher that indicates the cash value for a predetermined quantity of inputs or soil amendments. The farmer would give the voucher to a private dealer in exchange for the indicated type and quantity of items, but would pay only the difference between the market price of the items and the cash value of the voucher. The dealer would be able to redeem the voucher from a government-

authorized financial institution. This voucher scheme could also be considered in the early stages of agricultural development for smallholder farmers on marginal land and for rehabilitating the agriculture sector in strife-torn countries. However, the voucher scheme should be carefully planned for transparency and to avoid pitfalls. The program should also have an exit strategy to prevent it from continuing into perpetuity.

African farmers do not have to wait until investments in soil improvement have been made or until the improved socioeconomic and policy environments have become a reality. IFDC has developed strategic site selection as an approach, enabling farmers to benefit from locally or regionally favorable conditions to adopt integrated soil fertility management (Schreurs, Maatman, and Dangbegnon 2002; Breman 2002). The adoption of integrated soil fertility management in areas where at least some of the conditions discussed earlier are fulfilled enlarges the concerned locations and regions and increases the number of crops for which the conditions are favorable enough to consider intensification.

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Developing Smallholder Water Resource Strategies

M. A. Quiñones and Hune Nega

Food security remains at the core of rural development strategies for most countries of sub-Saharan Africa. However, the key question in rural development, how can we raise more food? remains unanswered.

Most of the population of sub-Saharan Africa is rural, and agriculture is the mainstay of people's livelihoods. The contribution of the agricultural sector to the total economy ranges from around 30 to 60 percent of the GDP from one country to another. However, this sector still is dominated by subsistence rainfed agriculture. Due to climatic changes in the region over the last 30 years, the rains are becoming more scarce and unpredictable. In many countries, cyclical droughts are causing food shortages and are a source of concern for most governments. During 2001/02, widespread droughts in southern Africa and the Horn of Africa brought famine and suffering to nearly 40 million people.

Agriculture will remain the primary mover for economic growth for a long time to come. However, a productive agriculture requires not only good, fertile soil and stable moisture supply, but good husbandry as well. At present, sub-Saharan Africa's vast land resources are being severely degraded, and the fertility of agricultural land is falling rapidly. Governments in sub-Saharan Africa must give special attention to the agricultural sector, focusing on reversing this trend and making a productive, commercial agriculture the main pillar for sustained economic growth. Efficient use of water in smallholder irrigation systems will play a key role in sustaining a smallholder commercial agriculture.

Water Availability

A few countries in sub-Saharan Africa, such as Botswana, that have a very low water balance per capita are turning from agricultural development to the development of other sectors of the economy to produce enough income to import the food they need. Most countries in sub-Saharan Africa, however, receive fair amounts of rainfall. They should be asking: How can we irrigate more land? And how can we make irrigation more efficient?

Because of geophysical impediments, the increasing costs to develop large-scale irrigation systems, and the competition for water from other sectors of the economy, this paper focuses on the strategic importance of developing efficient, smallholder drip irrigation systems that include rainwater harvesting, lifting water from shallow permanent streams, rivers, or lakes, and tapping underground water bodies that

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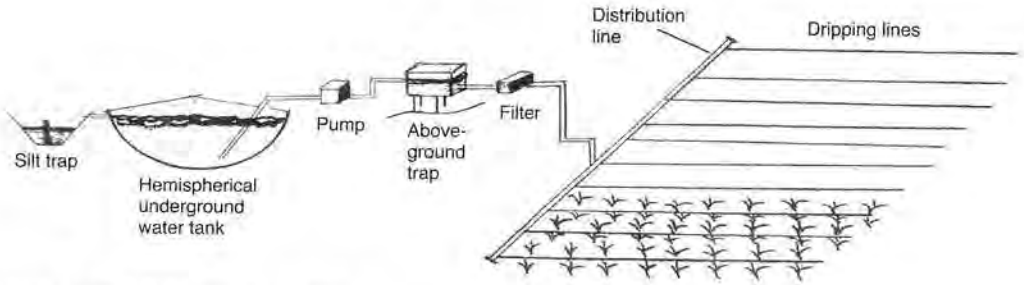

Fig. 1. Diagram of a family drip system.

have natural recharge. This paper touches on larger issues—water resource policies, strategies, and capacity building—that will affect rural development in the future.

Smallholder Drip Irrigation

Micro-irrigation technology has been widely known since the mid-1960s. It was pioneered by Simha Blass in Israel, and this country still remains at the forefront in drip irrigation innovations. In drip irrigation, precisely controlled amounts of water and fertilizers are delivered directly to plant roots. The system uses long capillary tubes that move the water from a water reservoir source (inlet) to a water outlet at the other end. Water traveling in the capillary tube can be leaked in droplets at chosen intervals to irrigate the roots of crops. Drip irrigation eliminates water waste and increases crop yields in most environments. Drip irrigation can include a range of options from highly sophisticated computerized controlled deliveries and advanced filtration systems for medium to large agricultural operations, on one hand, to cost-effective, household drip system units for smallholder plots, which deliver irrigation water by gravity, on the other. This paper deals with the latter.

Commercial companies are doing research on ways to adapt the benefits of drip irrigation to the special needs of smallholders. Netafim, an Israeli firm, has designed an innovative system often referred to as the family drip system (FDS). This system is relatively inexpensive and simple to operate and maintain. FDS is a gravity-based (no external power force is required) drip irrigation system designed to cover a crop field of 100 to 1,000 square meters, which can be planted with vegetables, perennial fruit trees, or annual crops such as cereals. FDS includes all components of a standard drip system except a pump. A farmer who tills more than 500 square meters of cropland can combine several units in a cluster, all connected to the same water source. FDS components are a water tank (supplied by the farmer), valve, filter, distribution or main pipe, drip lines, and connectors (fig. 1).

Family drip systems offer smallholder farmers numerous benefits. Each drop of water contributes to higher yield, i.e., more crop per water drop, crop quality is higher, water is distributed more evenly, water consumption is controlled more easily, less fertilizer is wasted, weed problems are diminished by placing the water directly in the crop root zone, less evaporation occurs, low humidity retards development of diseases, and labor and maintenance needs are minimal.

The system requires a water pump to connect the water source to an aboveground tank. From the tank, water is delivered by gravity through an outlet connected to a main distribution pipe that runs parallel to the head of the rows at the commencement of the field (fig. 2). Drip lines are connected to the distribution pipe and run inside the plot alongside the crop. The drip lines

Fig. 2. Family drip system operated by a smallholder in Ethiopia.

distribute the water, and the fertilizer dissolved into it, by leaking droplets at specified intervals close to the crop root zone. A set of manually operated valves controls the whole system.

The water tank should be located at the edge of the plot and at least 1.2 to 1.5 meters above the ground. The height of the tank affects the gravity pressure at which the system operates. The water capacity of the aboveground tank should not be less than the daily volume of water consumption. The tank can be plastic, cement, or metal. It can be filled by a manual or treadle pump, a windmill, or a central water distribution system, depending on the specific situation. The water source can be any kind of dam, shallow stream, river, lake, canal, borehole, underground cistern, etc.

If a cluster system is established, such as using one common pumping station to service several farmers simultaneously, a pump installed near the water supply will lift water to a tank located high enough to permit gravity flow to service all farmers. Each farmer will need to construct an aboveground tank near his or her plots. All multiple water tanks can be connected to the main tank above the ground by a distribution pipe network.

In sub-Saharan Africa, solar operated pumps have advantages over the mechanical ones because the need for fuel is eliminated and service and maintenance costs are minimal. Solar pumps are readily available, and when the capital costs are divided among several users they are very competitive with other options.

Harvesting Rainwater

Rainwater runoff can be collected from various catchment areas such as ground surfaces, seasonal watercourses, and building roofs. It can then be stored in tanks, ponds, basins, or other artificial reservoirs. From there, the water can be directed to cultivated plots for crop production, or it can be a supply source for livestock, domestic consumption, or other productive uses. This paper describes only the water harvesting techniques that use tanks for collecting and storing runoff mainly from ground surfaces and using the water for crop and livestock production.

Harvesting ground runoff usually involves the construction of a water channel through which the runoff can be led to underground tanks to be stored for later use. The catchment area is usually much larger than the cropping area intended to be irrigated and may be hundred of meters away.

Handling and storing large amounts of runoff water requires special skills. Organizations that are considering using this method should consult a specialist for technical advice. Mistakes are easily made, wasting time and money, and eroding credibility with the local people.

Potential for Harvesting Rainwater

Rainwater harvesting techniques are applicable in all agroclimatic zones of sub-Saharan Africa. But they are particularly useful in areas where permanent water sources like rivers, shallow wells, and

springs are scarce or uneconomical to develop, in marginal rainfed environments where low and erratic rainfall makes agricultural production very risky, in areas short of water for human and animal consumption, and in semi-arid areas where land degradation is diminishing the potential for production. In semi-arid areas, providing water through rainwater harvesting can improve the vegetative cover and enhance resource conservation.

Rainwater harvesting is one of the most important options for addressing household food security in drought-affected, moisture-stressed environments for several reasons. First, in moisture-stressed areas, rainwater can be made available more easily than other sources of water. Second, water captured through rainwater harvesting requires low levels of external energy for its extraction or transportation. Third, rainwater-harvesting technologies can be easily implemented using family labor and locally available materials. Fourth, it has low initial investment costs and is simple to manage and service. Fifth, the collection, safe storage, and use of rainwater can save time and labor, which may be used in other income-earning activities. Sixth, by improving labor productivity, rainwater harvesting can help create additional employment and agroprocessing opportunities for rural people. Seventh, marginal lands can be brought back into high production. Finally, soil fertility can be improved and soil erosion drastically reduced.

Construction of Tanks

All rainwater-harvesting systems need a place for storing water such as an excavated or embankment pond, dams, the soil itself, or tanks. This paper focuses only on underground water tanks. Tanks may store water collected from ground surfaces, from tin rooftops, from greenhouses, and from springs, streams, and rivers. The stored water can be used for irrigating crops (as supplementary or full irrigation, or both), supplying water for livestock, household needs, or any combination of these.

Depending their size and type, water tanks may serve individual households, groups of households, or the whole community. In general, larger tanks cost more than individual structures, but are cheaper per cubic meter of water stored. They also are more difficult to construct and manage.

Before a rainwater harvesting scheme is identified, a preliminary situation analysis survey should be carried out in collaboration with people in the community. It is important for beneficiaries to support the idea: it should be theirs to begin with. Beneficiaries should clearly understand the options available to them. They should decide what type of tank to construct because they will be responsible for operating and maintaining it. Ideally, they may even construct the tanks themselves. By doing so, resource utilization (capital, labor, and time) can be significantly improved, avoiding abuse and unnecessary expenses. Some other points to consider in the survey:

- availability of alternative water sources like springs, wells, and rivers for domestic purposes or watering animals, and the suitability of those sources for irrigation use
- the main problems in obtaining water from existing water sources (distance to source, water quality)
- availability of a protected enclosure (catchment area)
- availability of land for tank construction
- the purpose (domestic consumption, livestock watering, small-scale irrigation, or some combination) for which the stored water will be used
- amount of water that will be needed in a year
- availability of land to be irrigated

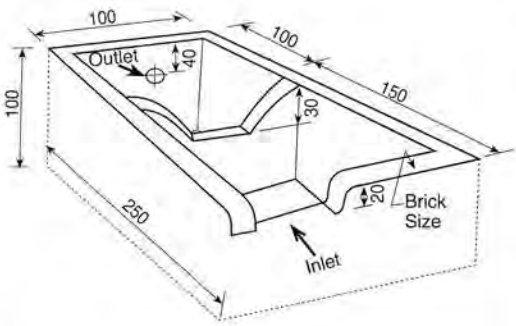

Fig. 3. Design of a silt trap with two chambers.

- whether the household or community is willing to participate fully in tank construction (contributing labor and providing local materials)
- amount of labor and hand tools that will be available for tank construction

System Components

The main components of a complete system for rainwater harvesting are the catchment area, a diversion channel, a silt trap or sediment pond, and storage tank.

Catchment Area. A catchment area is a natural or man-made unit draining runoff water to a common point. There are several important considerations in selecting the catchment area. First, the catchment area must collect sufficient runoff water to meet the designed storage capacity or to meet the users' needs. Soils that tend to form a crust during hard rain can generate considerable runoff. If the soil contains a lot of sand, another surface to collect runoff should be found. Second, the runoff water collected from the catchment area should be easily diverted to the storage tank. Third, the catchment area should be distant from pollution sources (toilets, animal sheds) and must be protected from contamination. Finally, the catchment area must generate as little sediment as possible. Appropriate soil conservation measures should be employed to reduce the amount of silt that is carried in to the tank.

Fig 4. Silt trap with two siltation chambers.

Diversion Channels. The diversion channel leads water from the catchment area to the silt trap and into the tank. It should be made of compacted earth or lined with cement. It should have a very gentle gradient to keep it from being damaged or eroded. If the catchment area is a rooftop, a gutter and flush guard should be fixed to carry water from the roof into the silt trap and the tank.

Sedimentation Pond / Silt Trap. A silt trap is a small pit used to catch sediment carried by the water. It prevents the tank from becoming clogged. The size of the trap depends on the amount of runoff (heavier runoff means a bigger trap) and the amount of sediment it carries. If there is a lot of sediment, a two-chamber silt trap is desirable—one chamber to catch sand and the second one to trap finer silt (fig. 3). A filter mesh should also be installed to trap leaves, twigs, and other debris before the water drains into the tanks. The siltation pond should be dug at least 3 meters away from the storage tank to prevent water from overtopping during heavy rains and damaging the tank (fig. 4).

Design of Tanks. How much water is collected from a given catchment area is the key consideration in the design of water

tanks to harvest rainwater. Rainwater yield varies with the size and soil texture of the catchment area. A smoother, cleaner, and more impervious catchment area contributes a greater quantity of runoff water. In general, the amount of runoff from a catchment depends on the following:

1. The size of the catchment. Large areas produce more runoff.

2. The type of the soil surface the rain falls on. Sand and grass absorb more water than do compacted and rock surfaces.

3. The intensity of the rainfall. A light shower has a chance to sink into the ground. Heavy or continuous rains produce more runoff, especially late in the rainy season when the soil is already wet.

4. The slope and length of the catchment. The steeper and shorter the catchment, the more runoff will be generated. Steep slopes with long length, however, will produce less runoff. The flatter the area, the less runoff will be produced.

In theory, if no water is lost, 1 millimeter of rainfall should produce 1 liter of runoff water from every square meter of catchment. But the actual amount is never this much because some water seeps into the ground and some evaporates into the atmosphere.

To estimate the amount of yearly runoff from a catchment, one must know the average amount of monthly or annual rainfall, the size of the catchment, and the percentage of runoff, which is termed the runoff coefficient *(K)*:

Runoff (mm) =
rainfall depth (mm) x catchment area (m^2) x *K*

Tables 1 and 2 show the percentage of total rainfall (value of runoff coefficient) that can be collected as runoff from various surfaces. These figures are approximate—the actual amount can vary considerably.

Site Selection and Location of Water Tanks. The water tank will be a permanent construction so selecting a suitable site is important. A preliminary study should be carried out before designing and constructing the tank. Two or more locations should be compared if possible.

There are several important points to consider in selecting the most practical site. The tanks should be located where the largest amount of water can be stored with the least amount of digging or earth fill. If the tank will be used for watering animals, the construction should be near where the animals are kept. Or if the tank will be used to irrigate crops, it should be near the field. To protect the water from contamination, the tank should placed at a site where drainage from farmsteads, feedlots, sewage lines, or other sources of pollution cannot reach it. Unstable ground, such as gullies or sites prone to landslides, or locations near deep-rooted trees should be avoided. Trees with deep roots should not be planted near the tank. Finally, the possibility of the tank suddenly collapsing and releasing water

Table 1. Percentage of runoff (or value of runoff coefficient, *K*) from various surfaces under different rainfall regimes.

	Annual rainfall (mm)		
Surface	250 to 500	500 to 1,000	1,000 to 1,500
Corrugated iron sheet	85	85	85
Rock	75	75	75
Thatch roof	20	20	20
Concrete floor	80	82	85
Agricultural field	20	30	45
Compacted soil	45	50	55
Plastic floor/roof	88	88	88
Sparse grass	10	20	40
Dense grass	10	20	35

Sources: Thomas 2003; Ministry of Water Resources 2001.

Table 2. Percentage of runoff (or value of runoff coefficient, K) from various surfaces for various topographies and land uses.

Land use and soil texture	Flat (0–5%)	Rolling (5–10%)	Hilly (10–30%)
Woodland			
Sandy loam	10	25	30
Clay and silt loam	30	35	50
Clay	40	50	60
Pasture			
Sandy loam	10	16	22
Clay and silt loam	30	36	42
Clay	40	55	60
Cultivated			
Sandy loam	30	40	52
Clay and silt loam	50	60	72
Clay	60	70	82
Urban			
30% of the area is impervious	40	50	–
50% of the area is impervious	55	65	–
70% of the area is impervious	65	80	–

Source: Hudson 1993.

should be considered. The site selected for the tank should be safe, and the tank should have a solid foundation under it.

Estimating Water Demand. Even if the harvested water is intended for agricultural purposes, some of the water is likely to be used for domestic consumption as well. Therefore, this use will need to be factored in when estimating total rainwater storage needs.

Since the amount of water that households consume varies according to the climate and living conditions, it is difficult to assess household water demand precisely. Household consumption includes the water used for drinking, cooking, bathing, and sanitary purposes, plus water supply for small animals.

Water use varies widely from season to season. The normal variation in demand should be determined in order to design water tanks. The volume of water stored will relate not only to available runoff that can be harvested but also to the cost of the storage. Other significant considerations in a household context that relate to water storage are length of dry season, number of family members, livestock number in the household, distance from existing water sources, activities at home and other demands on time, amount and quality of water at sources, travel time and waiting time at water sources, and health and age of household members.

In designing water tanks, therefore, the objective must be to reduce the burden on the rural households in a pre-determined number of years in such a way that the farmer can achieve the benefit and can also replicate the system.

When planning a water tank, it is important to know how much water will be needed. Household water use depends on many factors. In Ethiopia, the following figures are used as a rough guide to daily consumption: people, 15 liters per person; cattle, 25 liters per animal; horses and donkeys, 20 liters per animal; sheep and goats, 10 liters per animal; poultry, 15 liters per 100 birds; camels, 50 liters per animal.

To get the right size of water tank, the calculated water demand should be increased by about 20 percent to allow for losses such as evaporation, seepage, and overconsumption. The fact that easy access can increase consumption should not be overlooked.

Example of Farm/Livestock Enterprises Using Drip Irrigation Systems. In Ethiopia, Sasakawa-Global 2000 developed a smallholder drip irrigation system model that permits smallholder farmers to harness water from rain runoff or shallow streams (underground shallow aquifers will soon be incorporated into this model). The model starts with the provision of credit to smallholder farmers to allow them to construct underground water tanks to capture and store rainwater runoff. If water will be lifted from shallow streams, the credit is used to purchase the family drip system components described earlier. When farmers store rainwater for mixed crop/livestock operations, the capacity is usually 110 to 120 cubic meters. When the water is to be used only for livestock operations, the volume stored is halved.

Farmers who store rainwater face a limited supply of water, and they must carefully select the types of crops and area to be planted. Under Ethiopia's bimodal rainfall pattern, however, farmers can usually double their storage capacity by filling the tanks twice in a year. They fill the tanks once during the short rains and use all the water to grow crops before the onset of the long rains. They fill the tanks again during the long rains and use this water before the onset of the next short season rains of the following year.

Ethiopian farmers who use harvested rainwater and drip irrigation systems can grow up to three vegetable crops a year on most of their land, which usually ranges from 300 to 500 square meters (fig. 5). By carefully selecting the kind of crops they grow, the marketing of their produce has been going very well since they started this system over 4 years ago. Usually, farmers avoid planting large areas to highly perishable crops like tomatoes, lettuce, and cabbage. They prefer to plant more manageable crops like onions, garlic, peppers, or

Fig. 5. Onions and peppers grown with drip irrigation.

pineapples that afford longer marketing periods. In addition, farmers have been growing a combination of fruit trees such as papaya, avocado, mango, guava, and citrus. After these trees become deep-rooted, their water requirements become almost nil. The fruits they produce not only enrich the diets for farmers' families, but most of the time there are also marketable surpluses.

Once farmers have a stable water supply, their ingenuity and entrepreneurship emerges. Many have begun poultry operations, others have added beekeeping, and some are starting to fatten small ruminants (sheep) as an enterprise. Improved lactating dairy cows are being purchased. These operations were not possible previously when an unstable water supply was the main stumbling block. Feed production does not represent any problem since most of the feed or fodder is produced within the farm, and the minerals and other needs can be purchased with part of the income generated by the same animals.

The veterinary extension system is helping farmers to follow proper animal husbandry. Also, farmers are being trained to produce cheese, butter, and other dairy products. Prospective operations will be

Fig. 6. A dammed shallow permanent stream in Ethiopia.

focused on adding value to farmers' production. For instance, all of the mango, avocado, and citrus varieties they grow are high quality and have export potential. These varieties were deliberately selected because when many farmers produce the same kind of fruits, their combined production can be pooled to reach the economies of scale needed for national and export markets.

Drip Irrigation by Lifting Water from Streams

Most countries in sub-Saharan Africa have many shallow permanent streams that run unimpeded throughout the year. These streams could be easily dammed and the water lifted to irrigate land along the stream or river bank. Irrigation development of shallow rivers and streams is economically attractive for a variety of reasons: no resettlement of people is required, because no flood waters are induced; simple and low cost technology is used; the irrigation schemes are usually operated by the stakeholders without government involvement; only minimal supporting infrastructure development is necessary; access to irrigation water throughout the year allows farmers to plan the production of high value crops accordingly; and farmers can participate in the project design, implementation, and management from the beginning. Figure 6 shows one such development project in Ethiopia.

The use of water in surface irrigation has been proven to be highly inefficient. Under optimal conditions, the efficiency of such systems hardly reaches 30 percent. As a result, because the total volume of water availability is the main barrier to expanding land area under crop production, the best alternative is to transform such irrigation schemes into drip irrigation systems.

Since the water source can be a river, lake, or permanent stream, the farmer's concern is less about water limitation than about efficiency. This simply means that the farmer is free to plan the growing of any crop to respond to the market or to operate mixed livestock/crop enterprises, provided he or she manages the system well. Farmers who benefit from such schemes usually opt to engage heavily in both livestock and farm enterprises.

From the outset, it is important to ensure that farmers will agree to become organized in compact groups. Groups help their members avoid competition among themselves. And group members have a considerable advantage in being able to assemble resources and meet market demands as one solid entity, rather than individually.

Exploiting Groundwater Resources

Groundwater is one of the most reliable and least-used resources for smallholder irrigation systems in sub-Saharan Africa. Groundwater can be used for both home consumption and irrigation. When combined with a drip irrigation system, the use of groundwater becomes quite economical, and it can be exploited sustainably.

When exploiting underground water resources for community irrigation development, the system that is best adapted requires the formation of clusters of

farmers using a common tubewell. Farmers organized into groups (of up to 25 farmers) can assemble resources to purchase a motor pump (or solar pump) that moves water from the water source (borehole) to a main aboveground water tank. The tank should be raised high enough above the ground to permit water to flow easily by gravity to individual farmers' tanks through a pipe network. The farmers can then use the water on individual plots, the standard family drip system unit of 500 square meters, described earlier.

Water Resource Strategies and Human Capacity

Water is today considered by international institutions and most national governments as an economic and social good. In fact, since the United Nations Earth Summit in Rio de Janeiro in 1992, water has been recognized as the main environmental challenge facing the 21st century. Achieving environmentally sustainable development requires establishing adequate policies for all areas of water resources, identifying strategies to enforce those policies, and developing the capability for their implementation.

International institutions working in sub-Saharan Africa agree that long-term climatic predictions for the region make the prospects for food security gloomy. It is imperative for African governments to come to grips with the situation and to formulate correct policies that will lead to a sustained water development for rural areas.

The paramount consideration when identifying rural water development policies is the need for community participation in project design, implementation, and management.

When defining water policies, it is important to realize that management of the resource should be holistic. That is to say, it should take into consideration as many areas and consequences as possible. Water must always be treated as an economic and social good, and society as a whole, including the private sector and local NGOs, should have a voice in the management of this resource.

Also, because water frequently runs across international borders, it is crucial for countries to work together. Mutually developed water policies not only prevent conflicts, but lead to the development and management of the resource for mutual benefit.

Yet, water policies and strategies for their implementation are meaningless if African countries lack the human capital to implement and enforce those policies themselves. African nations through NEPAD have made the right choice to take control of the development process. The area of human capacity-building is crucial. Each African country is in the process of setting an overall development plan prepared and managed by local talent. It is to be hoped that water development will be considered a central pillar of rural development.

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Constraints in Developing Smallholder Input Delivery Systems

Lars A. Wiersholm

At the end of 1980s and early 1990s, when the socialist system was abolished in most African countries, we at Norsk Hydro were optimistic. Liberalization of the economy and structural adjustment was the name of the game. Norsk Hydro registered companies in several African countries to import fertilizer and build a distribution system. In our view farmers had suffered long enough with deliveries of fertilizer that arrived too late in the cropping season and that often were the wrong type of fertilizer. The farmer needed the right fertilizer at the right time for planting, and the private sector was capable of handling it. We expected that African economies would grow due to the potential for significant development of the agricultural sector and that farmers would prosper.

We spent a lot of time and money to determine the best types of fertilizer for special crops cultivated under various climates. For example, we were convinced that Ethiopia would follow suit with the other countries and that the World Bank would persuade the government to allow the private sector in Ethiopia, in partnership with foreign companies, to import agricultural inputs themselves. I toured the coffee-growing areas of Ethiopia together with Ethiopian experts to assess the right fertilizer to be applied, since diammonium phosphate and urea, the only fertilizers available, would never meet the nutrient requirement of the coffee tree.

We were wrong. the tender business is still the base for import into Ethiopia, and our agent is happy to benefit from the agency fees being paid rather than having to risk investing in a delivery system for reaching the farmers with his fertilizer in competition with others.

In Tanzania the company was closed down at an early stage due to shortage of foreign exchange for private imports. In Zimbabwe, where we are partners in the local fertilizer industry, we wanted to develop sales outlets in rural areas to give farmers access to agricultural inputs. There, the large farmers picked up the fertilizer in trucks at the factory gate, but for the small farmers it was far more troublesome. We were never able to convince the managers of those fertilizer companies that this was economical and the right thing to do.

Obviously we were not alone in hoping to develop distribution systems for agricultural inputs in Africa. In the early 1990s, SG 2000 came to the Hydro headquarters in Oslo, inviting us to cooperate in making fertilizer available to the farmers. SG 2000 was expanding its activities in Africa, demonstrating both to the farmers and governments what could be achieved with well-known cultivation technologies. Hydro has had a long and fruitful relationship with SG 2000, but I believe they expected far more from Hydro than we were able to contribute. At the same time, they fully understood that

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a sustainable distribution system has to be based on good economic criteria.

The Rockefeller Foundation also approached us. They had invested significantly in agricultural research in western Kenya, and they hoped that the commercial sector would follow up and make agricultural inputs available at the farmers' doorsteps. We traveled, studied, and made reports, but we could not find an economic base for building such a system. The main reason was that small farmers were not organized into groups or cooper-atives to secure a market for the food surpluses they produced. The farmers would therefore not be able to make a profit from selling their surpluses. Any distribution system that was subsidized and developed would not be sustainable for the same reason. If the farmers do not make money, neither do the input suppliers.

Cash Crops and Availability of Agricultural Inputs

It's easy to become emotional talking about depletion of African soils and declining productivity, which will be more and more difficult to restore to an acceptable level. We at Norsk Hydro increasingly refer to the "poverty trap" (fig. 1). It is a simple way to explain the nutrient circle and the need for a nutrient balance account on each farm. If nutrients are exported, they have to be replaced by organic material or mineral fertilizer. That should be fairly easy to explain to help NGOs and donor agencies understand the importance of maintaining soil productivity for the future. However, it does not make the farmers more profitable.

When we assess the sustainability of an input distribution system, our experiences have made us focus on the market for cash crops. It is essential that farmers be able to grow at least one cash crop and have access to a market for the product. Examples are coffee, cotton, sugarcane, and even maize in

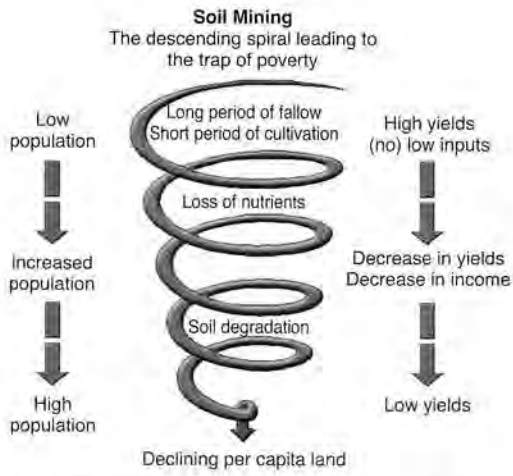

Fig. 1. The poverty trap. Source: Hydro Agri 2002.

some countries or under certain conditions. In West Africa a cash crop like cotton has formed the economic base for developing whole societies and even nations (Hydro Agri 2002).

A successful cash crop also stimulates increased production of food crops. The profit farmers make is devoted to increasing production on their present land or is invested in additional land. That is a win-win situation for the farming community as well as for the suppliers of farm inputs. It makes it attractive to invest in a distribution system to make sure that the inputs are available to the farmers.

International Events Deprive African Farmers of Profits

Regrettably, it is difficult to point to the cash crops that would justify an increased investment in farm input supply systems. The cash crops with potential to be profit generators for the small farmers in Africa hardly exist today. We are faced with a situation where farmers' incomes are declining, and the economic base for investments is disintegrating. As a result, the distribution systems for agricultural inputs that have been developed can easily fall apart due to reduced turnover and the

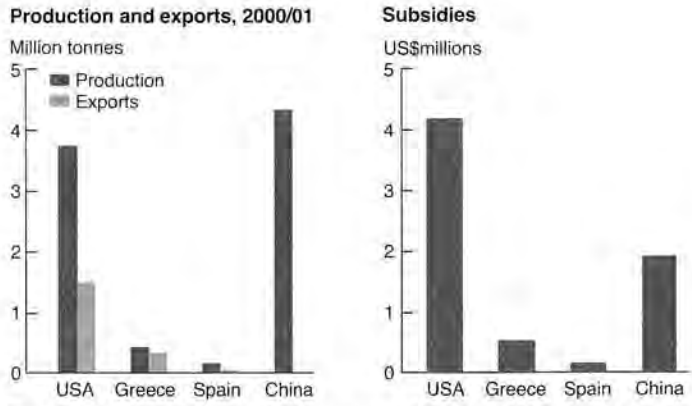

Fig. 2. Cotton subsidies result in overproduction and falling prices. Source: Hydro Agri 2002.

financial risks involved in making products available that are not readily sold during the cropping season. In large part the policies of developed nations are to blame.

Cotton

Subsidization of cotton production in the Western world, and in particular in the United States, undermines the income base for African farmers in cotton-producing countries in Africa (fig. 2).

The cotton success story in West Africa is now threatened. Unfair competition is hitting African exporters in a depressed cotton market. In addition, expansion by subsidized producers is destroying market balance and price levels. Consequently, nine African countries with 16 million farmers who depend on the income from cotton exports now face setbacks in their economic development, threats to their long efforts to develop and sustain well-organized agricultural production, and decreasing production intensification, meaning a return to soil mining, ruining of soil fertility, lower yields, and slowing progress.

Sugar

Oxfam (2002b) explains in detail how the European Union's US$1.6 billion sugar subsidy undermines the international market for sugar. First, it limits the volume of developing countries' exports to Europe. Second, it undercuts developing countries' exports in valuable third markets. And third, it depresses and destabilizes world prices (fig. 3).

Europe is the major exporter of sugar (fig. 4). Europe dumps excess production on the international market. In 2001 it exported 700,000 tonnes of white sugar to Algeria and 150,000 tonnes to Nigeria. Why is sugarbeet the most profitable arable crop in the UK (fig. 5)?

The cost of production of sugar in Africa is about one-third the cost of production in Europe. Developing countries such as Mozambique, Malawi, and Zambia are among the lowest cost producers of the world. Mozambique, for example, has lost the opportunity to earn an estimated US$106 million by 2004. That is almost three-

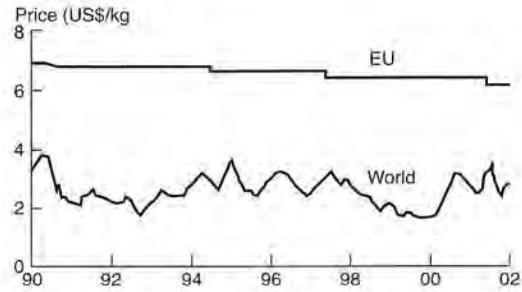

Fig. 3. European Union and world white sugar prices, 1990–2002. Source: Oxfam 2002b.

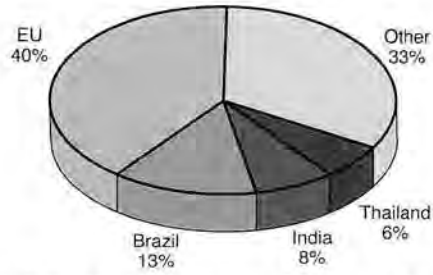

Fig. 4. World white sugar exports: Share of the market, 2000-01. Source: Oxfam 2002b.

quarters of the European Union's annual development aid to Mozambique.

Although a handful of African and Pacific developing countries receive valuable quota access to export their cane sugar to the European Union at a high price, they are limited to exporting raw sugar, to be processed in the European Union, thereby inhibiting the development of their own refining industries.

Coffee

Coffee is an important cash crop for farmers in many African countries and for the economies of a several countries (fig. 6). But coffee prices are at currently at rock bottom. Figure 7 gives a reasonable explanation for this development—increased production in Brazil and in Vietnam (while consumption of coffee has been declining).

Some say that depressed coffee prices are just temporary and that that they will bounce back. That is doubtful considering the large production increases in developing countries outside Africa. Also the consumption of coffee per capita is decreasing as the consumption of soft drinks rises. What profits there are in spite of the low prices do not, unfortunately, benefit the coffee farmer but remain mostly in the hands of the four or five big international distributors of coffee.

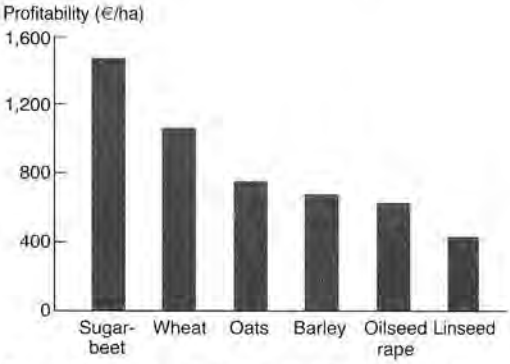

Fig. 5. Relative profitability of major UK arable crops, 2001. Source: Nix 2001.

Fair Trade: Max Havelaar

An organization called Max Havelaar has been launched in Europe and the United States that guarantees a minimum price to farmers growing tea, coffee, bananas, etc. The organization is doing a great job convincing consumers that they are supporting small farmers' livelihoods in developing countries by buying somewhat more expensive products. A significant breakthrough of this idea on the international market would give hope that farmers could revert to a profit-making business.

Few of us in the fertilizer business have taken the movement very seriously and established contact with their central

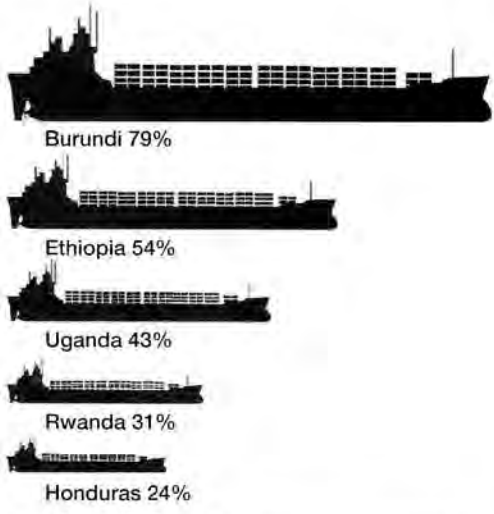

Fig. 6. Coffee exports as a percentage of total exports (2000). Source: Oxfam 2002a.

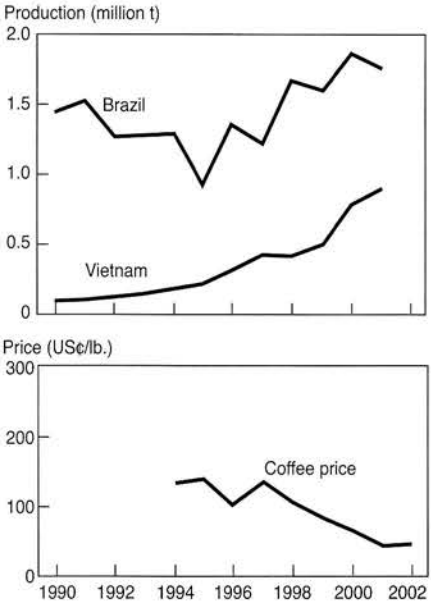

Fig. 7. Coffee production in Vietnam and Brazil. (Vietnam exports 90% and Brazil 65% of production.)

organization. To me, it is fair to say that we have failed to explain the connection between plant nutrition and crop production. Those who have taken it seriously are mainly representatives of the green movements who see an opportunity to promote their views of organic agriculture. The result is that the organization has adopted the idea that producers (small farmers) should implement a system they have named integrated crop management that minimizes the use of fertilizers and pesticides and gradually replaces them with organic fertilizers and biological disease control. Such a policy means a gradual reduction of crop production in farmers' fields because the farmer is unable to maintain sufficient nutrient balance on the farm through such practices. We are missing an opportunity by not engaging in a dialogue with these organizations and showing them that good quality products in consumer markets do not contradict modern cultivation practices.

Food Crops

Rather than discussing all the food crops produced and consumed in Africa, I will focus on maize. One would assume that at least maize could be considered a cash crop in most African countries. The predicament of the other cash crops discussed earlier could be excused due to international market conditions, etc., but maize is produced and consumed in Africa.

Maize was a cash crop in Zimbabwe until late 1980s. The policy of the Ian Smith government was to keep the equivalent of 1 year's consumption of maize as a strategic stock in case of drought, and the farmers would not plant before they knew what price would be paid for next year's harvest. The Mugabe government followed that practice until the World Bank and the international donor community forced it to sell the stocks off. It was said to be too costly for the country to keep such reserves. Just after Zimbabwe managed to deplete its stock of maize, it was hit by a serious drought. This year Malawi had 200,000 tonnes of maize in stock and was forced to export it just in time for the current drought.

SG 2000 has proved over and over that sub-Saharan African countries can produce an abundance of maize if encouraged by the international community. We do grow surplus food for strategic reasons in the West. Why is the same practice not advised in Africa where the gap between surpluses and famine is narrow?

I do not buy the World Bank's argument that these countries are too poor to be able to finance strategic food reserves. When famine strikes, the food always has to be supplied by Western countries due to lack of strategic reserves in Africa.

Maize would have been an excellent cash crop in many African countries. The farmers would have been offered a minimum price and a secured delivery at the end of the season. Such a policy would also establish a

sound base for gradually building the infrastructure for an input delivery system for small farmers.

The Supplier and the Customer

The economic environment described obviously does not justify the development of a regular delivery system of agricultural inputs. The economic incentives for investment are lacking and any investment represents a high risk. It is fine for local and foreign NGOs to advise how it should be done, but not so for the businesses that often have to invest heavily before any profit can be harvested.

Small-Scale Farmers

The small-scale farmer is the essential part of the system. Farmers can only buy and produce if they can sell their surplus production. The constraints small-scale farmers face can therefore not be repeated often enough. At this workshop in 1998, R. K. Evans of Homegrown (Kenya) Limited pointed out the following constraints experienced by the small farmer (Evans 1999):

- availability of quality seed and other inputs
- expensive inputs—no economies of scale
- unavailability of farm loans
- irregular visits by collectors or exporters
- nonremunerative prices
- unreliable information on market trends or when to plant
- poor transport
- harvest and post-harvest losses

Such farmers have no future on their own. It is essential that the small-scale farmers become better able to organize themselves. Most of us agree on this, but these formal or nonformal interactions among small farmers develop slowly. Why? Are we so occupied in all activities linked to crop production that we forget the farmers' own problems? Is it lack of funds for such activities, or is it that this is none of our business?

I have tried to follow the development of the National Smallholder Farmers' Association (Nasfam) in Malawi even before its incorporation in 1998. I remember how I was impressed by the way ACDI/VOCA[1] started working with the small farmers of Malawi. The representatives were looking for international market opportunities for some of the cash crops in Malawi, and they were frustrated that USAID refused to sponsor any activity related to tobacco. Nasfam is now a well-recognized force in Malawi, and foreign donors are keen to provide economic support. SG 2000 entered Malawi somewhat later with their program, and together the contributions from these two NGOs are significant.

I believe we will see strengthening of farmers' organization in other African countries as well, because it is a must for securing the economic future of small African farmers.

Rural Network of Stockists

How do you persuade local emerging businesspersons to become agricultural inputs stockists? Perhaps they believe a profit is to be made because they have few alternatives for making a living or because they are so convinced by the work we are doing in farmers' fields. The individual with that type of attitude seems hungry for business and is the person we are looking for. He or she will face numerous constraints by engaging in such business. The following list, which is based on the SG 2000 experience in Uganda in building a network of local stockists close to farmers, shows the constraints and their solutions.

- Lack of entrepreneurial skill: Train stockists in business management
- Lack of operational capital: Provide short-term loans
- Poor output marketing: Produce for

target/contract market

- Undeveloped horizontal and vertical linkage: Establish a rural stockist network
- Small volume and fragmented market : Encourage more aggressive promotion
- Poor information flow: Use mass media to advertise
- Unreliable supplies at peak periods: Encourage importers to stock early for the season
- Sale of expired or low grades products: A more vigilant national regulatory body
- Price fluctuation: Early purchase from the best supplier
- Lack of a competent technical advisor: Hire competent technical advisor

These points highlight the challenges facing any businessperson who opens a shop in a rural area. It also spells out the responsibility and the challenges we have in convincing businesspersons and helping them to enter the business and to succeed.

The Input Supplier

The input supplier will probably not be aggressive in the market environment described. The distribution chain will not be developed the way we expect it to be, but somewhat differently depending on whether the supplier is a local manufacturer or an international supplier. The local manufacturer will be more flexible in extending its activities. However, few African countries have a fertilizer manufacturer. The markets therefore have to rely on international suppliers, and they will basically consider the risks too high for investing in an integrated distribution system in Africa.

East Africa is an interesting marketplace to observe. Kenya's market of 250,000 to 300,000 tonnes of fertilizer is significant and more or less forms the base for what is happening in the surrounding markets, including Uganda where SG 2000 incubated a fertilizer stockist program.

Everything seemed to be done in the correct way in Uganda. The fertilizer market has gradually expanded from 10,000 tonnes to, today, 30,000 to 40,000 tonnes. This development has taken time and has not been as easy as expected at the start of the program.

It was not inevitable that a big fertilizer supplier would open warehouse and sales outlets in Uganda just because SG 2000 started a program. Mike Foster, the SG 2000 country director had to travel to Nairobi to buy fertilizer from Norsk Hydro because hardly any fertilizer was available in Uganda. He had to find fertilizer both for his program and for the farmers at reasonable prices. He learned the hard way how to get supplies of fertilizer, to obtain credit, and to pay on time for the fertilizer. A guarantee by SG 2000 was not sufficient when a deadline for payment was approaching.

Mike Foster finally managed to convince Norsk Hydro to open a warehouse in Kampala, making the fertilizer more easily available to farmers. It must therefore have been a disappointment when Norsk Hydro later closed the warehouse because it became too expensive. Renting a warehouse and paying for staff and security is costly, and the market was still fairly small. The market forces proved to be the strongest.

It was too expensive to import fertilizer through Mombassa and transport it to Kampala for storage in comparison with selling to Ugandan truckers and traders who came to Nairobi. They brought fruits and vegetables on 10- to 15-tonne trucks to the Nairobi markets and carried fertilizer back. The logistics makes more sense since fertilizer is always available in Nairobi at competitive prices, and the transporters know where to deliver the fertilizer in Uganda directly to distributors or wholesalers.

[1] Agricultural Cooperative Development International/ Volunteers in Overseas Cooperative Assistance

All this business is on a cash basis. I was amazed to learn that, although some of these operators have several trucks, they do not use bank finances for their business. Their business is only expanded with their own resources and those of friends and families. They do not trust banks. Banks ask for payment when money is not available and show little understanding of the characteristics of the business. Truckers consider it safer to manage on their own. When we therefore argue for bank finances, we have a sales job to do on such progressive business people.

Despite its considerable size, the Kenyan market remains based on cash sales. Farmers buy on a cash basis, and little credit is provided by stockists. The stockists or the wholesalers themselves operate on a cash basis and buy where they can get the best price unless they have developed a special business relation with a particular supplier.

Tanzania is another market where Norsk Hydro has been absent for the last few years. The reason is simple. The market remains small in comparison to what it used to be. Farmers' cooperatives have had an impact on market development. It has been an ideal marketplace for local traders who have been able to organize themselves efficiently, buying fruits and vegetables from farmers, bringing the produce to market in Dar es Salaam, and taking fertilizer back. They have also often been able to organize themselves for joint import of fertilizer at internationally competitive prices. It is probably not an ideal situation, but one we have to accept until the farmers are properly organized and can get a better price for their produce through their own market channels and are able to secure the agricultural inputs through competitive and reliable international suppliers. However, the presence of SG 2000 in Tanzania will ensure that the production of food will increase and the market for agricultural inputs will expand, providing a base for an even stiffer competition and the return of some of the big international operators in farm inputs.

Conclusion

The ideal model of the smallholders' input delivery system—the supplier develops the distribution channels all the way to the farmers—does not exist anymore. The risk for the "inventor" is too high, and the investment is too great. It is not as obvious as in the past that the farmers can make money in agricultural activity and therefore will be able to buy the inputs. We have to focus on the local, regional, and international market for agricultural outputs.

Clearly when farmers have a secure channel for delivery—a factory for processed products, an organized channel for bringing the products to market, a guaranteed minimum price for products, or even an auction floor—then they will produce, make money, and once again represent the "pull" factor in developing an input delivery system. Farmers in Africa will remain subsistence producers unless they are provided with some type of guarantee as to payment for their work and improvement of their incomes. This is a pity for the farmers, and it is negative for African societies since agriculture should form the backbone of economic development in African countries. The key to this lies with the West and its attitude toward removing its own subsidies and liberalizing the international markets for agricultural products. Recent reports from the Doha round of trade talks offer little optimism about a possible change in this situation in the near future. However, perhaps the Norwegian government is showing the way. It recently removed the import restrictions on agricultural products from the 47 least-developed countries.

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The Role of Agribusiness in Pro-Poor Development

Martin Evans

This paper considers the contribution that agribusiness can make to pro-poor development and how more private investment in pro-poor agribusiness might be encouraged.

The defining feature of agribusiness is that it is agriculture-based activity that is owned and organized primarily on a *commercial* basis. This paper adopts a broad definition of agribusiness to include commercial farming itself as well as the upstream activities (mainly input supply and service provision) and downstream activities (mainly processing and marketing) linked to it. The focus, however, is on agribusiness that processes or otherwise adds value to the products of farming before they enter the marketing chains that lead to the end user.

The emphasis also is on *privately* owned and financed agribusiness. In recent years, most governments have been attempting to dispose of their direct investments in production and distribution. In some countries, this has left a gap in the market with negative consequences for pro-poor development. The issue, therefore, is why these gaps have not been filled by private enterprise and whether this situation can be changed for the better.

In this context, it is helpful to distinguish between the private provision of publicly funded services and the replacement of the latter by services that users obtain from the marketplace. To take one example, the delivery of agricultural extension services is increasingly being contracted out to private companies, NGOs, or even individuals (see, for example, Rivera and Zijp 2002). Full market development of such services, however, can be really achieved only when the end users are willing and able to purchase the services for themselves; i.e., when no public funding is involved (for discussion of some of these issues, see Byerlee and Echeverria 2002).

Pro-Poor Agribusiness Activities

Agribusiness can assist pro-poor agricultural growth in a number of ways. One is by adding greater value to outputs the poor produce with resources that they control, which usually means providing strong demand and good prices in well-functioning markets for the poor's products and helping the poor to gain access to superior and appropriate technology and to acquire the knowledge, skills, inputs, and credit needed to use it. Another way is by introducing or reinforcing patterns of production, consumption, and distribution that reduce the vulnerability of the poor to external shocks like poor weather, low prices, and natural

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disasters, which means ensuring the poor continue to have access to food, healthcare, inputs, credit, infrastructure, etc., even when times are bad. A third way is by pushing policy and institutional changes in directions that, directly or indirectly, strengthen the property rights of poor people, their market power, and representation in councils of decision-making.

Essentially, these three mechanisms for promoting pro-poor agricultural growth address the key issues of the productivity, vulnerability, and empowerment of poor rural people.

Adopting the broad definition of agribusiness and applying these criteria, we can identify the several types of pro-poor agribusiness activity:

1. Market enhancement—agribusiness that creates new or bigger or better markets for products that the poor can supply. The prime examples are agri-processing and marketing enterprises.

2. Supply facilitation—agribusiness that supplies the poor with the tools needed to produce, profitably and safely, output in the quantity and of the quality demanded by the market. The prime examples are input distributors, including providers of mechanized agricultural services.

3. Rural development—agribusiness that provides infrastructure, facilities, and services in rural areas and that, directly or indirectly, benefits poor communities.

4. Equity unlocking—agribusiness that requires the use of the poor's resources (almost invariably lands, forests, and water) for its own operations and pays a dividend or rent to the owners or rightful users of these resources that otherwise have little or no market value. The principal examples are farmers' and forest owners' trust schemes and corporately managed land consolidations.

5. Farmer empowerment—agribusiness that depends for its success on poor farmers being organized for technology transfer and the coordinated production of raw material, resulting in the farmers acquiring greater economic power in factor and product markets and having greater control over their economic destiny.

Examples from the Sugar Industry

The following examples taken from the cane sugar industry differ with regard to the manner in which the agribusinesses concerned have evolved and in the relative importance of the above types of pro-poor activity. Two of the three cases are from outside Africa, but they are fully relevant to the African situation. The third is an example from Kenya.

Nghe An Tate & Lyle

Nghe An Tate & Lyle is a joint venture between Tate & Lyle PLC and the Nghe An Provincial Government in one of the poorest rural areas of Vietnam. The project began commercial sugar production in 1998. It was initially perceived by the investors as a classic agro-processing enterprise: the foreign partner provides the plant, the local partner provides the road infrastructure into the intended cane-growing hinterland, and both assume the local farmers will respond of their own accord to the new market opportunity that has appeared in their midst.

But most farmers had no previous experience in commercial sugarcane production; they would need a lot of practical help and strong incentives to get established. That fact was overlooked (although it had been pointed out in a feasibility study undertaken by Booker Tate), which proved costly in the early years when cane supplies proved insufficient to meet factory capacity. Once the lessons were learned, however, the company established a full extension service and helped organize an effective credit

system. Significant changes were also made in the system of payment. Instead of paying, after some delay, with cane measurement based on large lots comprising several farmers' deliveries, payment was made immediately in cash on delivery of individual farmer's truckloads. Another important development was the outsourcing of cane haulage to local private contractors.[1] As a result of these improvements, cane supply increased rapidly, so much so that factory expansion is being considered.

This project provides *market enhancement* for people who have hitherto had very limited outlets for cash crops (some maize and groundnuts) and, belatedly, is also now *supply facilitating*. The road construction and improvement program contributed to rural development. The project has already had a substantial impact on disposable income in the local community with, among other results, a conspicuous expansion of new housing in the surrounding villages.

Ramu Sugar Limited

Ramu Sugar Limited, in Papua New Guinea, originally 49 percent state-owned, was conceived by the first government of the newly independent nation as insurance against a recurrence of the swinging hikes in world food and energy prices of the 1970s. National self-sufficiency in sugar was therefore a key justification for this project in addition to rural job creation, provision of infrastructure and services, skill transfer, local business stimulation, tax revenues, and foreign exchange saving. Ramu Sugar (RSL), which began commercial production in 1983, was located in a relatively remote and underdeveloped part of the country with a low population density.[2]

Unlike Nghe An Tate & Lyle, which relies totally on small farmers for its raw material, RSL grows three-quarters of the sugarcane it needs for sugar and ethanol production on its own corporate farm of 8,000 hectares. The indigenous communities were, and are, too small to manage the cultivation of enough cane themselves although they own a lot of land. Initially, RSL sought to encourage the local population to become independent commercial sugarcane farmers under contract to the company, and, in an agreement with the government, a cane pricing formula based on the sugar price was established. However, the owners of the land were reluctant to cultivate it on this basis despite the establishment of a dedicated extension service to assist them. Possibly they were deterred by price uncertainty, erratic input availability, unfamiliar technology, or aversion to debt. For whatever reason, most of the outgrowers were content to let RSL farm their land for them under an arrangement that is a combination of fixed lease and sugar-yield-based income sharing.[3] They still have the option of selling their labor or their management of certain agricultural operations to the enterprise.

A greater socioeconomic impact of RSL, however, has been the creation of a township of 10,000 people in what had previously been an area of almost empty bush and rough grazing. People were recruited by RSL from all over Papua New Guinea, and there is now a second-generation company population living and working there. In addition to requiring all the usual community facilities such as schools, medical clinics, banks, shops, churches, police posts, market areas, playing fields, transportation, etc., the Ramu township is a large market for food (meat, fruit, vegetables) grown as much as 100 kilometers away.

The company has been profitable, although a major setback in its early years due to a rare sugarcane disease (until then unknown to science) delayed the retirement of offshore debt, which meant that dividend payments began only recently. In terms of

pro-poor benefits, RSL has meant a degree of market enhancement (though not for its own products), but the scope for supply facilitation has proved relatively insignificant. The main pro-poor benefit has been *rural development*.

The project required substantial investment in transport and access infrastructure (roads, bridges, drainage) for the estate operations and for input and product shipment and in community facilities to support the on-site resident workforce. This investment helped to improve the access of the local poor to markets, services, and productive resources. RSL also had to provide vocational training to raise the productivity of its employees (this was the first commercial sugar project in the country). Over the years, this skill acquisition and growing market opportunities have stimulated local entrepreneurs who have set up businesses to service the township and, to some extent, the agribusiness enterprise itself.

This agribusiness project, with its multiple industries (RSL also runs a cattle herd and meat processing plant), infrastructure, communications, power generators, workshops, stores, and community support facilities, has almost certainly deepened and broadened the local and regional economies to a greater extent than anything a government could sensibly have sought from direct expenditure on infrastructure and services over a similar time period.[4]

It will also be apparent that RSL has been an *equity unlocker* by conferring a realizable commercial value on the otherwise underutilized or low productivity land of the local population.

Mumias Sugar Company

Mumias Sugar Company (MSC) began commercial sugar production in 1972 as a parastatal enterprise in an underdeveloped area of western Kenya where local livelihoods were based mainly on subsistence agriculture.[5] The original concept was for the company to grow a substantial proportion of its total sugarcane requirements on its own corporate farm. This plan would guarantee a minimum level of throughput in the factory and reduce the risk exposure of the investment in fixed assets that had few, if any, alternative uses. At the same time, the corporate farm would develop sugarcane-growing technology suitable for small farmers and introduce this to the surrounding population supported by an extension service, assistance with obtaining inputs, and a credit scheme administered on behalf of local banks.

This form of production organization is often used for the major tree crops (coffee, tea, oil palm, cocoa, rubber), as well as for cotton, sugarcane, sisal, fruits, vegetables, tobacco, milk, and poultry. The corporate farm and central processing unit is the nucleus for surrounding smallholder or

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[1] The organization and control of cane harvesting and haulage remains with the company which uses GPS information to schedule the collection of cane by contractors from individual farmers' fields. (For maximum sugar extraction, cane has to be processed as quickly as possible after being cut.)

[2] Booker Tate undertook the original feasibility study in 1979, managed the construction of the project during 1980–82, and acted as corporate manager of RSL during 1982–2000. Since then Booker Tate has been acting as technical manager.

[3] In fact, this was a rational response of the local farmers whose scarcest resources were labor and management skills, not land, unlike their counterparts at Nghe An Tate & Lyle in Vietnam. The assessment of the Papua New Guinea farmers was that RSL, with its mechanized harvesting as well as cultivation operations, was more likely than they were to get the best productivity from the land.

[4] Sugarcane processing projects are particularly conducive to broad-based rural development because they combine relative heavy industrial activity with commercial agriculture. Importantly, they are also self-reliant in the energy required for processing and for power supply to the resident community.

[5] Booker Tate undertook the original feasibility study in 1969, managed the construction of the project during 1970–72, and acted as corporate manager of MSC during 1972–2003.

outgrower development,[6] serving both as a market for the independent farmers' raw product and as an R&D-extension-input supply center for the farmers. Less common are projects of this type that process beef cattle, pigs, and bio-fuel materials supplied by small farmers.

The outgrower component of the project grew rapidly and the 3,500-hectare nucleus estate area quickly shrank to insignificance as a source of cane for the sugar factory. From 6,000 farmers on 10,000 hectares in 1976, MSC today has contracts with more than 50,000 farmers cultivating 46,500 hectares. In fact, it is estimated that around 60,000 outgrowers in total supply cane. The project area is now roughly as large as the area bounded by the M25 motorway around London.

Success brought its own problems, however, with sugarcane (grown by men) crowding out land (used by women) for food production for the home and market, despite MSC's efforts initially to limit the area of sugarcane per farmer.[7] The Mumias area is now an importer of food from surrounding areas that do not grow sugarcane. Nevertheless, standards of living have improved as evidenced by consumption levels and a range of social development indicators.

Important factors in the outgrower expansion included the secure land titles held by individual farmers, which facilitated their access to credit, and a major road construction program to link outgrower areas to the factory. As the factory has gone through several stages of expansion and technological upgrading, so has the amount and diversity of outsourcing opportunities for small rural businesses (builders, mechanics, fabricators, haulers, etc.).

MSC has thus performed a *rural development* role in addition to its *market enhancing* and *supply facilitating* roles. Moreover, it has also contributed significantly to *farmer empowerment*. MSC helped local farmers establish the Mumias Outgrowers Company to represent growers' interests, to facilitate the effective delivery by MSC of extension, inputs, and credit to outgrowers, and to coordinate the har-vesting and delivery of cane. Over time, Mumias Outgrowers Company has developed substantial bargaining power, not only in relation to its business with MSC, but also in local politics.

MSC has been consistently profitable and was privatized last year. The cane farmers purchased 30 percent of MSC's shares, which are now listed on the Nairobi stock exchange, with the help of a savings scheme organized by Mumias Outgrowers Company and MSC.

Finally, it is interesting to note that Tate & Lyle's Vietnamese partners in the Nghe An sugar project visited Mumias during the feasibility study of their own project in order to understand the kind of impact such a development could have in their own locality.

Examples from the Poultry Sector

Hybrid Poultry Farm Limited, Zambia, and Kenchic Limited, Kenya,[8] are organized on the corporate (nucleus) farm/processor-outgrower model of Mumias Sugar Company, but the products are poultry meat and eggs. Hybrid produces 12 million broiler and layer chicks per year, and Kenchic produces 3 million.

Both sell most of their chicks to small farmers; the remainder are reared, processed, and marketed by the companies. Under contract growing schemes, the farmers rear the chicks using a feed and vaccine package provided by the companies. After 6 weeks the birds are sold back to the companies for processing and marketing. Both companies operate substantial extension services for the farmers and help arrange credit for them.

Hybrid in particular was very successful commercially, exporting large numbers of day-old chicks to Angola and Zimbabwe, among other destinations, despite problems with unscheduled stopovers by the airline carriers.

Hybrid's main problem was the erratic availability of maize for feed. Purchases of maize for feed competed with human food supplies, and the company was prohibited, from time to time, from importing maize. This situation forced Hybrid to investigate other feed sources. It eventually developed a soybean-based feed, using grain grown on its own farms, which largely replaced the previous maize-based formulation. As a consequence, the import content of the feed and vaccine package distributed to farmers was reduced to less than 10 percent by value.

Kenchic faced various marketing problems, not least of which was that it competed in the high-quality end of the market with another source of eggs and poultry meat that enjoyed high political patronage and would from time to time be granted special privileges. Despite developing a chain of Kenchic Inns, the company was pushed into a segment of the market where its products competed with low-quality poultry meat and beef. Kenchic struggled to maintain sales volumes.

Arranging credit for Kenchic's farmer-customers was another difficulty. The banks regarded this activity as a high-risk operation on the grounds that the farmers could sell their birds anywhere, leaving Kenchic without any recourse.

Nevertheless, both companies, which were established more than 20 years ago, are still operating profitably. Their main pro-poor contributions were *market enhancement* and *supply facilitation*. There may also have been some degree of farmer empowerment, but this is less clear-cut.

Stimulating Investment in Pro-Poor Agribusiness

As was said at another recent NEPAD conference, "[private] capital seeks opportunity, never need."[9] Investment by agribusiness in pro-poor activities is primarily undertaken for two reasons:

- the existence of a commercial opportunity, the pursuit of which happens to result in benefits for the poor
- the need to maintain good public relations by providing facilities and services that, intentionally or otherwise, benefit the poor but are not central to the operation of the agribusiness

If private investment in pro-poor agribusiness is not forthcoming, it means that the commercial incentives are inadequate or the provision of nonessential facilities and services for the poor are not perceived to be a necessary condition for successful operation. Government can clearly do something about the former, but may find it less easy to do anything about the latter. Unlike the mining and oil and gas extraction industries, where the granting of investment approval or an operating license is often conditional on the private investor developing "social projects," many agribusinesses are too small to be able to afford to make a significant impact in this manner.

The most effective approach, therefore, is likely to be ensuring that commercial incentives encourage agribusiness to source its raw material from poor farmers instead

[6] Indonesian terminology extends the cytological analogy by referring to the outgrower area surrounding the nucleus estate as "plasma."

[7] Over time, the average size of farmers' sugarcane plots becomes smaller anyway, mainly due to sub-division among family members. In recent years, this has meant that the average plot is too small to provide an adequate income from sugarcane alone.

[8] Both these enterprises were managed by Booker Tate for a number of years, but are now managed by their owners.

[9] European NEPAD Investment Conference, London, 20 January 2003

of growing it on its own corporate farms (where land availability makes this option feasible) or to locate its operations in poor rural areas (where agroclimatic suitability for the product concerned makes this feasible).

As in most other businesses, the key commercial driver of agribusiness expansion is the prospect of exploiting a remunerative market at an acceptable level of risk. For agri-processors, the main focus of this paper, the market aspect usually boils down to achievable product *price* relative to production *cost* (for assumed sales volumes). The *risk* aspect usually hinges on the quality and quantity of raw material supply relative to the minimum throughput and processing performance needed to cover the fixed and irrevocably committed costs of the processing plant. For this reason, relying on independent, small farmers for raw material supply is often seen as risky by agro-processors and the associated management costs of providing supporting facilities and services as high, as opposed to the risks and costs of corporate farming on company-owned land or leased land.

Public interventions, therefore, may be needed to increase the profitability (higher prices or lower costs) of pro-poor agribusiness or to reduce the risk to private investment in it. The risk aspect will be briefly considered first, then the price/cost aspect.

Risk-Reducing Public Interventions

Considering the economic situation in many parts of Africa today, it is hard to escape the conclusion that there is still a considerable need for conventional development financing of the commercial agriculture sector, particularly to encourage pro-poor types of private activity. The retreat or, sometimes, complete withdrawal from this arena by some development financing institutions in recent years is surely premature. Agriculture is a long-term, risky business (for which no universally satisfactory system of insurance has yet been devised), often generating only relatively modest returns at best.[10] The availability of investment funds at reasonable cost, whether provided alongside private investment in the project as public loan co-financing or integrated with the private investment in an equity joint venture, at least reduces the risk exposure of the private investor.

Now is probably not the best time to float an "emerging-markets agribusiness fund" to tap the world's capital markets for investment in pro-poor projects! With appetite for risk low, the private equity markets are most unlikely to invest in a "blind pool" where the fund managers are left to identify the projects. The need for such a fund exists, however, and unless it comes into being, development-financing institutions will have to continue to provide the substitutes.

Profitability-Enhancing Public Interventions

The crucial importance of price for driving private agribusiness investment cannot be ignored. This not only applies to a production business but also to a service business. An input supply service for small farmers, for example, requires smallholder farming to be cash-profitable. An agribusiness can work on the cost side of the equation by investing in improved productivity and (where appropriate) in scale expansion to reduce unit costs, but it cannot do anything about the price side.

Lars Wiersholm (in the previous chapter in this proceedings) has given salutary examples of how low commodity prices have undermined smallholder input-delivery schemes in Africa. Fertilizer is critical to agricultural growth in many parts of Africa, which generally suffers from nutrient-poor soils. However, several attempts by agrochemical companies to

develop distribution systems (purchasing, transportation, storage, etc.) to reach small farmers have been abandoned because of the fundamental nonprofitability of the cash crops for which the fertilizer was intended.

It should not be forgotten that the successful green revolution in Asia was underpinned by price support or input-cost subsidy schemes in most countries. The result was that, following the widespread uptake of more resource-efficient grain production technology, real prices for food (the wage goods) ended up much lower than they otherwise would have been but were still profitable for the farmer and affordable for the poor consumer. This was the agriculture-first model of development put to the test. India still fixes minimum support prices for farm products (and has fair-price shops for the poor consumer).

Limited duration price support interventions can be used to encourage private investment in pro-poor agribusiness with the objective of increasing productivity, reducing costs, and improving market competitiveness. The underlying policy principle must be that this temporary public support will be self-eliminating in that the need for it will disappear. First, it is necessary to determine whether the threat to the pro-poor agri-processors' commercial viability is due to primary cost efficiency being too low or to product prices being too low. If the former, then there may be a solution at the enterprise level. If the latter, then there may be no solution other than price interventions at the macroeconomic level (see the following section). Second, if primary cost efficiency is the problem, it is necessary to determine whether *potential* primary cost efficiency—what can be achieved in those particular agroclimatic conditions under good management and operating at an appropriate scale—is high enough to ensure viability.[11] If potential primary cost efficiency looks promising, relative to international industry benchmarks, then there is a prima facie case for temporary public intervention.

Price support interventions based on placing constraints on international trade though import tariffs and quotas represent a kind of socioeconomic pact between producers and consumers, instituted and mediated by government. To consumers, government is saying, we know that we are denying you the opportunity to buy as much of the imported product as you want at its landed price, which is lower than the price of the homegrown product, but we believe the import price is not a fair one and/or, given some help, our producers will be able to compete with imports in due course. To producers, government is (or should be) saying, we will allow you to enjoy higher prices for a time by protecting the domestic market from cheaper imports, but you must use this breathing space to become more efficient and reduce production costs—and we will help you do this (we do, after all, have some extra revenue coming in from the customs duties and quota auctions).

The Wider Picture

Market liberalization and globalization are exposing increasing numbers of small, poor farmers to world prices. For some important commodities derived from crops that these farmers grow, international markets are distorted by protectionist farm income support policies. The primary cause is the heavy protection or support given by developed countries to their own high-cost

[10] The irony of the former Commonwealth Development Corporation reducing its portfolio of agribusiness investments because they yielded insufficient returns will not be lost on Third World farmers.

[11] The assessment of primary cost efficiency applies to the growers' as well as to the processors' operations because the maximum price the processor can afford to pay for raw material must not be less than the minimum price at which the grower can afford to sell it.

producers. This protection either restricts international trade, and consequently depresses prices for low-cost producers by denying them access to the developed countries' internal markets, or it subsidizes the high-cost producers, even to the extent of making it profitable for them to export in some cases. When developing countries are obliged to respond with some protection or support of their own, they are roundly criticized by the development community for adopting wasteful economic policies.

This conference is about finding ways of moving small farmers off the narrow livelihood base of subsistence agriculture and toward the broader horizons of the market economy. Yet, so often, the market fails these farmers who trip up on the very uneven, sometimes steeply sloping, playing fields of international competition. They find that they cannot compete with the imported product that is selling in their own market at very low prices, not because the foreign suppliers are super-efficient but because the foreign firms enjoy special support from their own governments. The result is a theoretical absurdity: that even the production of basic staples by the developing country farmer is, according to economic analysis, an uneconomic use of national resources. The practical effect is just as absurd but, more important, also deeply damaging to the farmers' welfare: by being unable to sell to their own domestic markets they are being denied the opportunity to move from subsistence to sustainable agriculture.

Until agricultural prices are freely formed in fair markets, we should, in the words of Prof. Rodrik (2001), be careful not to let "global integration . . . become a substitute for a development strategy."

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Food Security Strategies and Poverty Eradication in Africa

Richard Mkandawire

The protracted and deep-rooted economic crisis that has affected nearly every country in sub-Saharan Africa has adversely impacted the well-being of the majority of people (Mayor and Binde 2001; Sarr 2000; Basu and Stewart 1993; Mustapha 1992). As a consequence, many Africans continue to experience a decline in their welfare owing to a fall in real incomes and a smaller social sector expenditure per head (Basu and Stewart 1993).

This fall in welfare, which appears to have been exacerbated in a number of countries by war, civil strife, and environmental disasters, is manifest in the general decline or reversals in major social indicators of progress. Reports of the World Bank and United Nations agencies demonstrate that over 40 percent of the population of sub-Saharan Africa is living in absolute poverty or on purchasing power parity of less than US$1 per day. As a consequence many Africans are not able to feed themselves.

It is estimated that about a third of sub-Saharan Africa' population remains chronically hungry. In Africa as a whole, the number of undernourished people rose from 173 million in 1990–92 to 200 million in 1997–99. Some 97 percent of the continent's food insecure live in the countries of sub-Saharan Africa where 34 percent of the population is classified as undernourished.

In the mid-1990s, of the 32 million victims of disasters receiving relief assistance from the World Food Program, 21.5 million were living in Africa. In 2001, the number of Africans affected by food emergencies ranged from 23 to 28 million.

In terms of exports too, agriculture has generally performed poorly, with the share of African agricultural exports in world markets falling from 8 percent in 1971–80 to 3.4 percent in 1991–2000. The value of agricultural exports is growing extremely slowly, from US$12 billion in 1990 to US$14 billion in 2000 (NEPAD 2000).

The World Food Program estimates that 14 million people currently face famine in Kenya and Somalia. About the same numbers are affected in Zambia, Malawi, Zimbabwe, and Mozambique. In countries like Zimbabwe and Somalia, the crisis has been aggravated by conflicts and government policies.

NEPAD has given high priority to agriculture and food security. NEPAD intends to address poverty and hunger in the continent through partnerships among African institutions as well as between Africa and the international community. More critically, NEPAD has recognized that rural communities and civil societies must be at the center in addressing the challenges of poverty and hunger.

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What Has Gone Wrong?

No single factor can be blamed for the food crisis facing most countries. Factors such as persistent drought, civil strife, rising population pressure and environment degradation, lack of access to markets for agriculture commodities, inappropriate agricultural policies, and lack of physical and social infrastructure in the rural economy militate against sustainable agricultural productivity and food security.

Food insecurity therefore is the result of a confluence of factors. The raging conflicts in Africa and drought in parts of southern Africa alone need not cause food insecurity. However conflicts, be it in the Great Lakes region, Côte d'Ivoire, or indeed Zimbabwe, combined with a fragile resource base and inappropriate policies can lead to disrupted farming operations, unavailability of labor, erratic operation of markets, or unregulated exploitation of natural resources, all of which undermine the economic development of local communities and exacerbate food insecurity.

Therefore, it is critical that government and other stakeholders take a holistic view, not only in assessing the causes, but also in exploring interventions that will lead toward food security.

Food security itself, by definition, is not simply about availability of food; it also entails accessibility, that is, the ability of individuals or a nation to acquire food on a sustainable basis. Food security is also about the reliability and distribution of food. The former relates to utilization and consumption of safe and nutritious food, while the latter relates to the equitable provision of food to points of demand at the right time and place.

Interventions to Address Food Insecurity

Given the enormity of the food crisis confronting most African countries, it is critical that countries focus on areas that will be able to yield the highest social returns for food-deficit households.

Initiatives such as the World Summit on Sustainable Development and NEPAD have emerged in the face of growing poverty, human deprivation, and environmental degradation. The World Summit has succeeded in generating a sense of urgency, commitment for actions, and partnerships to achieve measurable results. Some of the interventions proposed in this paper should be seen against the backdrop of the outcomes of the World Summit on Sustainable Development. These include:

- reaffirming sustainable development as a central element of the international agenda and giving new impetus to global action to fight poverty and protect the environment
- broadening and strengthened understanding of sustainable development, particularly the important linkages between poverty, food security, the environment, and use of natural resources
- the international community's special attention to Africa and NEPAD to focus efforts on Africa's development needs
- commitments, targets, and time-frames on poverty eradication
- the goal of halving the world population whose income is below $1 a day and the proportion of people who suffer from hunger by 2015

In this paper the interventions proposed should not be perceived as panaceas for overcoming food insecurity; rather they are pointers to areas or issues that have over time proven to provide a basis for addressing the problem of food insecurity in Africa and elsewhere in the developing world.

Increasing Smallholder Production

Most governments are committed to increasing agricultural production among food-insecure households. However no single

intervention is the answer to increasing food production. While increased use of fertilizers is critical to increasing productivity, there is recognition that this should be combined with other interventions including those linked to access to productive resources, such as land, technology, credit, and training. These interventions, however, are unlikely to materialize unless they are backed by strong commitments to investing in the agricultural sector to maintain the productive capacity of the land, water, and genetic resources.

There is evidence for instance that investment in agricultural research has declined considerably over the past decades. As a consequence, with the exception of a few centers of excellence, research institutions that were reputable in generating technologies for smallholder farmers a decade ago are no longer making groundbreaking discoveries. Not surprisingly, therefore, the extension system and extension workers, like most public servants, are increasingly becoming alienated from farmers. Technologies they disseminate to farmers are obsolete, repetitive, and not in sync with the farmer's needs.

Levels of production are low among most smallholder farmers in Africa. There is therefore potential for them to increase productivity though the adoption of new technologies and improved management practices. This notion of course assumes that the nature of technologies as well as extension workers have the capacity to address the unique needs of smallholder producers. International as well as local research and development activities must take into account the assets, knowledge, capabilities, and needs of small-scale producers.

For instance, among some agriculturalists in Africa, there is still a thinly disguised contempt for traditional farming systems and technologies. Mixed cropping, the practice of growing two or more crops simultaneously on the same piece of land, often is disparaged. Farmers who plant mixtures tend to be branded as conservative, ignorant, obtuse, lazy, or unprogressive. Yet many researchers now recognize that mixed cropping is a sophisticated and appropriate farming practice for most smallholder farmers.

Nevertheless some countries in sub-Saharan Africa are shifting toward large-scale commercial farmers, who own leasehold or freehold land and who, as in the colonial period, are perceived as more efficient than smallholder producers. Yet there is no evidence to support the assumption that smallholder producers under customary tenure systems utilize their land any less efficiently or that they are inhibited from investing in land.

Some well-placed organizations, including donors, remain unconvinced that indigenous African farming systems, technologies, and institutions offer hope for increasing agricultural productivity. For instance, as Matlosa (1993) observes, in Lesotho as in other countries in the Southern African Development Community, prevailing customary tenure arrangements have been generally condemned. They are perceived as backward and a stumbling block to increasing agriculture productivity. Privatizing land through leasehold or freehold is considered the answer to increasing agricultural productivity.

As evidence would show elsewhere in Africa, many smallholder farmers continue to practice traditional intensive systems of agriculture, which have evolved over centuries as a means of counteracting low fertility. These included the farming systems of the Watengo in South West Tanzania, the Wakara on Ukara Island in Lake Victoria, and the Shona of Zimbabwe. The Watengo and Wakara systems have effectively integrated livestock and crops on organic

farming principles. The Shona system involves the symbiotic use of woodland to sustain livestock for their byproducts and land for agricultural production.

Elsewhere, to offset rainfall variability, rivers have for been used for decades to supplement irrigation, as with the WaChagga on the slopes of Mount Kilimanjaro and the Lozi in Western Zambia.

Agricultural research and extension need to take into account traditional and other systems that allow intensification using mainly locally available resources as a strategy in poverty reduction. For instance, agroforestry practices in Malawi, Tanzania, and Kenya have proved particularly beneficial for women who have been empowered to control their own natural resources and to gain access nearer their villages not only to fuelwood but also to folder for their animals.

Increased Support for Research and Extension

Most agricultural research and extension institutions in Africa are not well funded. As a result, the role of research in raising agricultural productivity and the role of extension in facilitating adoption of new technologies are both increasingly being questioned. The assumption that researchers and extension workers are custodians of technologies and information, which should be supplied to farmers, should be challenged. The supply-driven approach undermines farmers' own capacities as innovative and thinking individuals, capable of discerning their own needs and demanding what they want. Smallholder producers are capable of not only defining and articulating their own requirements, but they are also able to organize themselves to access technologies, service produce markets, and able to conduct their own agricultural experiments.

Extension workers should move away from supplying prepackaged or blanket information toward a more flexible and holistic approach in addressing the needs of small producers. Small producers need a wide range of products to enhance their livelihood needs. Extension workers should therefore provide the necessary facilitation in supporting farmers' demands, which might not be limited to agricultural products. Small producers have demand for savings, consumer goods, consumption-smoothing loans, etc. All these have major implications for secure livelihoods.

Unfortunately extension workers have not been adequately trained to meet the practical requirements of smallholder producers. Some extension workers find it difficult to move away from how they have been schooled, that is, supplying information and not expecting small producers to make demands or articulate their needs.

There is clearly a case for government to increase spending on agricultural research and extension. Increased investment in research and extension is a key factor in increasing agricultural productivity, thereby helping to stimulate growth, generate income, and reduce poverty. Growth in agricultural productivity can stimulate the economy by raising the incomes of producers, who then spend the resources on nontradable goods and services like housing. More critically, both researchers and agriculture extension workers need to be reoriented to tailor their research as well as information and services to the wide range of needs of smallholder producers.

In the context of NEPAD, it is worth exploring the initiation of regional training programs for agricultural researchers and extension workers. South Africa, through the National Agricultural Research Council, has developed a unique research program that offers a limited number of young graduates an opportunity to participate in a

professional development program that is strongly linked to small- and large-scale farmers. The program equips young people with a wide range of both scientific and human-centered skills. Young researchers are attached to senior researchers, who mentor them, while they are simultaneously pursuing their studies. The mentoring processes include field experience that exposes them to the practical problems faced by smallholder or large-scale producers. Besides exposure to various research and development methodologies and their practical application in agricultural research, the young researchers are also given life skills training, including those related to working and dealing with problems of the smallholder producers.

This unique agricultural research program is human centered, and it blends science with the practical realities the researcher is likely to face on the ground. It might be worth exploring how this type of a training and mentoring research program could be replicated in other African countries.

Creating a Voice for Farmers' Organizations

It is critical that governments and international partners help create farmers' organizations that are democratic and are able to mobilize local communities to address national food security concerns. Farmers' organizations have a deep understanding of their local environment and their constituencies.

In Africa a number of farmers' organizations are beginning to articulate their demands to enhance the livelihood opportunities of their members.. These organizations have considerable capacity to share knowledge and their varied experiences in agriculture through, for example, farmer-to-farmer visits. Additionally they can play a central role in lobbying to influence government policies.

Documenting and Sharing Models of Good Practice

While models of good practice in Africa's agriculture are well recognized in most countries, the degree to which they are practiced or supported varies from country to country. What is clear is that these practices are not widely shared at the national level, let alone the regional level. Little documentation exists on how these practices or a combination of them are critical to increasing smallholder agriculture productivity and promoting food security.

It is therefore not uncommon to see the reinventing of the wheel in agricultural development programs or indeed a repetition of well-proven failures, as "new" agricultural development initiatives. The result often is a waste of resources that could have been avoided if space had been provided for the sharing of knowledge and experiences. The sharing of relevant accessible information within each country and among countries could serve as a powerful tool in meeting some of the challenges of food insecurity in Africa.

NEPAD, with the support of donor partners, should begin documenting models of good agricultural practices in Africa. Documented good practice knowledge will be applied to creating a critical decision-making knowledge base that will enable policy makers, planners, and managers to develop appropriate policies. For example it will provide a better understanding of strategic direction—in terms of target farm groups, policy and programming, and constraining and enabling legislation—in stimulating agricultural productivity and food security.

Eventually a network could evolve, focusing on good agricultural practice. A network approach will give donors an opportunity to dialogue and work with each country's initiative and to support the development and implementation of

strategies that bring coherence and relevance to policy, program, and supporting institutional mechanisms.

Promoting Food Security

NEPAD recognizes the critical role women play in agriculture, as growers of food crops and providers of labor. Women's responsibilities of course go beyond the farm: they are involved in post-harvest processing and a wide range of reproductive activities. In most sub-Saharan countries, women spend more hours than men in the majority of farming tasks.

Women's contributions are particularly significant because many are heads of households. In southern Africa, female-headed households range from as low as 30 percent to as high as 60 percent. The highest incidence of female-headed households are typically in the labor-reserve economies like Lesotho, Swaziland, Malawi, and Botswana. Thus for most countries, female-headed households have emerged as a consequence of migration of males into urban areas. In a few countries, such as Zimbabwe and Malawi, there is also evidence of rural-to-rural migration, mostly movement of males from the peasant subsector into commercial or plantation agriculture, leaving women to take care of food production in the peasant subsector (Mkandawire and Matlosa 1993).

Most female-headed households have been identified as asset-less or poorly endowed households. The majority of the female-headed households tend to have only one resident adult, who is the principal provider of the family's sustenance.

The paradox of course is that although politicians and policy makers are aware that women are central to agricultural production, efforts to improve agricultural production tend to be directed at men rather than women. It is men rather than women who are exposed to innovations in technology, credit, extension, and land use.

Agricultural professionals—researchers, extensionists, and planners—are predominantly men. Consequently innovations developed tend to be male-biased, as is the manner of their dissemination. Women's food security concerns and their labor requirements are not taken into account in the design and dissemination of new seed technologies.

New and innovative strategies are required to address women's needs in agriculture. Governments and NGOs in the region may wish to experiment with women's group and cooperative approaches like those of the Grameen Bank in Bangladesh, which have proved successful in enabling asset-less women to undertake productive activities, thereby enhancing their capacity to respond to economic opportunities. Such group and grassroots approaches are especially important in helping women to overcome the wide range of patriarchal attitudes and red tape by enabling them to circumvent some of the socially and culturally derived barriers.

The Youth Dimension in Promoting Food Security

Compared with other regions of the world, Africa has the largest proportion of young people in its population. In countries such as Kenya, Tanzania, and Zambia, individuals aged 25 years or less constitute 70 percent or more of the population. Young people 15- to 25-years old constitute about 30 percent of the total population in most African countries (Chigunta and Mkandawire 2002).

While little detailed information on the situation of youth in Africa is available, given the high and growing incidence of poverty and the documented adverse social impact of economic restructuring, there is increasing concern that large numbers of young people have become marginalized or are excluded from education, healthcare, salaried jobs, and even access to the status of

adulthood (Bennell 2000; Mkandawire and Chigunta 1997; Schnurr and Newing 1997; Mkandawire 1996).

Failure to uncap the potential and skills of young women and men has serious implications for the future of Africa. There is potential for increased restiveness and political and social instability. The conflicts ranging across Africa are preying on young uneducated men and women, who with rather limited choices, find joining the ranks of fighters the only livelihood option. Young people are in effect the arsenal than keeps the wars of Africa raging. Countervailing strategies to offset this trend will prove more costly in the long term than what is required now to invest in their innate talents and livelihoods.

In the face of the raging debate on transforming African agriculture and poverty eradication, coordinated programs should be implemented on the national or regional level that will generate oppor-tunities and sustain livelihoods for young people and contribute to the well-being of their communities.

Government intervention is required, particularly for marginalized youth groups. Government intervention could focus in four areas: Mainstreaming youth in public policy, de-compartmentalizing youth livelihoods, youth-targeted initiatives, and partnership development.

Mainstreaming youth in public policy involves setting the scene through formulating employment and enterprise-related policies (especially macroeconomic and sectoral policies as well as council laws) to create a environment that promotes youth livelihood opportunities.

To decompartmentalize youth livelihoods, government can create a policy that specifically supports and directs the opportunities for youth enterprise promotion to provide a basis for strategy and program development. Youth-targeted initiatives means that the government designs programs and strategies that promote businesses owned and managed by young people. For instance, youth agricultural cooperatives could be promoted.

Partnership development involves facilitating links or partnerships between different stakeholders in youth enterprise development.

Emergency Preparedness

Decades of natural disasters and conflicts have adversely affected the food security circumstances of most African countries. For years people have been displaced from within or outside their national borders. In the 1960s in southern Africa, wars of liberation were instrumental in displacing populations. During the wars of liberation and subsequent civil wars in such countries as Mozambique and Angola, thousands of people were displaced from their homes, and others sought refuge in neighboring countries. In the Great Lakes region, and more recently in Côte d'Ivoire, hundreds of thousands of households have become homeless refugees in their own countries or in neighboring countries.

Food production in these countries is impaired not only at the household level, but also at the national level.

Notably in southern Africa and parts of eastern Africa, drought and flood have also been recurring phenomena. Governments in partnership with civil society organizations and other stakeholders should create emergency preparedness systems and programs. Regional collaboration would be appropriate as well. For instance, South Africa, which has adequate food reserves, could provide supplies to the neighboring countries such as Zimbabwe, Mozambique, Lesotho, and Malawi in times of food crisis. There is therefore an emerging need to establish food reserve strategies at the regional level.

Safety Nets for Food-Deficit Households

Safety nets intended to assist poor households and those caught in conflicts are not well developed in most African countries.

Poor households traditionally depend on their extended families to cushion them in the event of crop failures, famine, or natural disasters. Some communities periodically benefit from remittances from family members working in urban areas. However, such remittances are not able to meet most of their household requirements.

Governments should develop systems and infrastructure that could respond to national food emergencies and other disasters. Associated with responses to emergencies and their aftermath should be the creation of targeted safety nets to broaden access to food by vulnerable groups that do not have the capacity to increase their food supplies.

Addressing Communicable Diseases

Communicable diseases such malaria, tuberculosis, and HIV/AIDS should be taken into account in developing food security strategies. The HIV/AIDS pandemic adversely affects food production levels through its toll on rural households and communities.

In areas with high rates of HIV/AIDS infection, the consequences are not only loss of human capital from premature debility and death, but the diversion of labor of healthy individuals to care for the sick. Indeed young people may be required to maintain the household's current livelihoods or to develop new livelihoods, or to drop out of school to care for ailing parents. To-morrow's livelihoods are sacrificed for the survival of the household today. Ailing parents and other elders are not able to transfer their knowledge and skills to successive generations.

It is critical therefore that safety nets be established for families living under the difficult circumstances of taking care of those who are living with HIV/AIDS or those who have lost family members to HIV/AIDS, especially in circumstances where both parents have died and children have become household heads.

New approaches should be investigated to respond to the reality of HIV/AIDS and its impact on the agricultural sector. For instance, young people, who are increasingly assuming the role of household heads after losing family members, should be engaged and be party to the provision of agricultural services and other support requirements. The strategy could also include developing new crops that are able to meet the nutritional requirements of people living with HIV/AIDS. Discussions of HIV/AIDS should be mainstreamed in all agricultural service provision. Such information should targeted to high risk groups such as seasonal agriculture and estate workers as well as young people.

Promoting Regional Trade

Countries of the regional economic groupings have conducted relatively little trade in agricultural commodities and inputs among themselves. The main reasons are

- the long-standing orientation of most countries' external trade to countries in the North
- barriers provided by macroeconomic policies
- poor communication and transport links among member states

Although unofficial trade among countries within each region is widespread, the volume of this trade is not well known. In recent years, expanding and diversifying this intra-trade has been adopted as an objective of the sub-region's economic blocks to

- increase regional and national food security

- reduce the dependence of these countries on supplies and market outlets in the North
- enable regional firms to achieve economies of scale in production, processing, transport, and distribution
- improve the balance of payments position of grain-surplus countries

Besides agricultural commodities, there is clearly scope for increased intra-subregional trade in such agricultural inputs as seeds, farm machinery, fertilizers, livestock feed, and packaging material. Some of the relatively industrialized countries in the continent, such as Egypt and South Africa, have already developed specialized industries for many such commodities. It is unfortunate that ordinary men and women engaged in cross-border trade within the region tend to be scoffed at. They are usually portrayed as villains, sometimes brutalized and fined if caught. More research is required to examine the volume and type of this cross-border trade.

Engaging the Private Sector

The private sector remains peripheral to agricultural production in Africa. Partnership between government and private investors is essential for developing new knowledge, for processing and marketing agricultural products, for supplying agricultural inputs, and for providing services.

Improving the environment for private investment is essential. It requires a combination of regulatory reform, new institutional arrangements to overcome market failures, and the promotion of pro-poor investments and complementary physical investments.

Enablers in Enhancing Food Security

In addition to the cited interventions, the following enablers should be explored by regional economic groupings or by individual nations:

- developing food production capacity together with the expansion of cash crops and other farm enterprises
- formulating policies that enhance access to land, water, and biodiversity and equity in their use
- reforming global institutions, e.g., World Trade Organization and other United Nations agencies
- deepening the debates on intellectual property rights
- expanding knowledge and information systems
- improving agricultural infrastructure, particularly input supplies, storage, transport, processing, and financing
- establishing programs geared toward the control of major crop and livestock pests and diseases
- expanding capacity-building and skills-development programs
- expanding trade within each subregion
- effectively exchanging technical and economic information within the region

Conclusion

It would be remiss not to mention that there is an urgent case for broadening public debate on some of the socio-political and policy-related issues that underlie existing food insecurity and agriculture in the region.

NEPAD recognizes that to meet the World Food Summit goal of halving the number of undernourished people by 2015, it will have to forge partnerships within Africa. Also partnerships will be required with the international community in support of food programs. There is a need to explore new ways of addressing development. The development agenda should embrace new technologies, new scientific thinking, and exploring the inclusion of nontraditional partners. It is critical therefore that development practitioners begin to examine interventions beyond the borders of the agricultural sector.

NEPAD would like to encourage governments, the commercial private sector, and civil society organizations, including farmers' associations, to explore innovative approaches in designing and implementing sustainable agricultural development strategies that will enhance the livelihoods of millions of hungry people in Africa.

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Confronting the Impact of HIV/AIDS on Agricultural Development

Joseph Tumushabe

UNAIDS (2002) estimates that in Africa 28.5 million adults and children are living with HIV/AIDS. Some 2.2 million Africans died of AIDS in 2001 alone. In 12 African countries, at least 10 percent of those aged 15 to 49 are infected. Seven countries, all in southern Africa, now have prevalence rates higher than 20 percent: Botswana (38.8%), Lesotho (31%), Namibia (22.5%), South Africa (20.1%), Swaziland (33.4%), Zambia (21.5%), and Zimbabwe (33.7%).

Despite some notable declines in prevalence rates in Uganda, Senegal, and Zambia, the effects of the epidemic and associated mortality are going to remain for generations. In the next two decades, assuming that prevention, treatment, and care programs will have a modest effect on the growth and impact of the epidemic, 55 million Africans will die earlier than they would have in the absence of AIDS (UNAIDS 2002).

Currently, the higher rates of morbidity and mortality arising from HIV/AIDS are fast eroding the sustainability of household livelihood systems and strategies (Barnett 1994). Behind the threat to human livelihood in the region lies the negative effect of the epidemic on human resource supply and the increased demand for resources for treatment and care of the less-productive family members, notably young orphans and the sick. It is particularly ominous for agriculture in the region that young women, who constitute the bulk of agricultural labor force, account for the majority of persons living with HIV in sub-Saharan Africa.

Agriculture continues to be the mainstay of the national economies in eastern and southern Africa. Here close to 70 percent of the population lives in rural areas (FAO 2001). The livelihoods are mainly labor-intensive subsistence and cash cropping.

The significance of agricultural development is evident in the multiple stakeholders in the sector within the region at all economic levels (FAO 2001). To avoid significantly undermining investments that donors, governments, civil society organizations, communities, farm families, processors, and distributors are putting into agricultural and rural development, measures that would decrease the vulnerability of rural households to the HIV/AIDS epidemic need to be undertaken and integrated into innovations and ongoing operations.

At the household level, support mechanisms for mitigating the effects of AIDS on orphans and foster families urgently need to be identified. Where support mechanisms exist, there is a need to translate these lessons into community resilience and coping mechanisms that can be further strengthened and replicated at national or even regional levels. However,

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given the extent of the epidemic in sub-Saharan Africa, multiple initiatives for mitigating the effects of AIDS on the families and communities should be identified and ways to progressively build these initiatives into new and on-going policies, strategies, and activities must be found to check the effect of the epidemic on rural economies and agricultural development.

In July 1993, October 1994, June 2000, and April 2001, multiple studies were carried out in Uganda, Zambia, and Tanzania with common objectives: (a) to identify the impact of HIV/AIDS on agricultural productivity and rural livelihoods, (b) to identify the main determinants of the sustainability of improvements in rural livelihoods as linked to the various facets of the HIV/AIDS problem, and (c) to find the best lessons to proactively address these issues in order to mitigate their effects (human, social, and economic) on rural populations in eastern and southern Africa. For the present paper, these studies were supplemented with literature obtained from studies carried out in western and central Africa. The objectives of the latter studies include: (a) assessing whether households directly affected by the HIV epidemic were being reached by development projects, and, if not, to explore how such households could be included in on-going project activities, (b) exploring what activities can best mitigate the impact of the HIV epidemic, including appropriate entry points for HIV/AIDS activities and anticipated constraints, (c)) identifying the requirements for operationalizing the proposed HIV/AIDS mitigation and prevention activities, (d) assessing how and to what extent, HIV/AIDS had affected project staff; target groups; and project operations; and what the implications of these effects are for project operations.

Taken together, the studies that generated the findings below have used different methods applied to over 100 organizations, donors, government officers, extension staff, communities, and agricultural workplaces in all regions of sub-Saharan Africa. The findings, therefore, apply to all communities affected by HIV/AIDS.

Effects on Projects and Extension Operations

The list of AIDS effects on agriculture is inexhaustible, and though they vary from community to community and at household level, clear patterns are emerging. The downward spiral effect of HIV/AIDS on rural development and families in general is strikingly similar within and among many countries. An IFAD mission aimed at identifying modalities for mitigating the effects of HIV/AIDS in agricultural development programs of eastern and southern Africa showed that ill health and funerals disrupt attendance at development events organized by projects or government and community extension workers (IFAD 2001). As reported in Monze District, Zambia, increased mortality and incidence of funerals in the communities (camps) are forcing cancellation or postponement of planned activities. These setbacks add to the usual financial and transport constraints of extension departments and make timely attainment of program targets more difficult.

Participation in Extension Activities

AIDS disrupts capacity-building projects that train community leaders, contact farmers, or ordinary farmers generally. In the families where the sickness and death occurs, often no adult is easily available to attend meeting and activities. Family priorities shift toward caring for the sick and meeting urgent family needs rather than attending extension activities, which are considered long-term and not of immediate value to the family. When intended beneficiaries fail to attend the meetings, the extension messages are usually totally lost.

Trained Beneficiaries

Sickness among contact farmers in particular disrupts the project activities since they are often entrusted with organizing other farmers. When they are unable to do this and fail to inform the project staff about the disruption before a scheduled event, considerable time and resources are wasted. In Kolomo District of Zambia, it was reported that in the event of death or serious ill health of extension staff or innovative farmers, their knowledge, experience, and labor are also lost. This loss results in low rates of adoption of new technologies. It is also likely to slow the completion of projects.

Staff Workload and Morale

AIDS cases increase the workload of some departments. Agricultural departments reported that they have had to train new community workers and farmers because those they had hoped to rely on or already trained had died or were unable to work as a result of AIDS. Extension workers themselves may fall sick or have to care for sick relatives. In one district office in Zambia, 4 of the 22 extension staff members had died in the previous year. Three of the deaths were the result of AIDS. Similarly high staff mortality was reported in Uganda. For the Community Development Department under the IFAD-funded District Development Support Programme (DDSP), AIDS was reported in two of the three districts visited to have increased their workload. As land and property insecurity of orphans and widows increases, the demand for the attention of the community courts as well as probation and welfare offices also increases.

AIDS also affects staff morale. In both Uganda and Zambia, staff salaries are generally low compared with the cost of living. The costs of caring for sick relatives or widows or orphans of relatives strains the incomes of concerned staff. Difficulty in meeting basic family needs lowers working morale.

Frequent absences, because some staff have to be away from their jobs when they are sick, or have to care for sick relatives, or have to organize or attend funerals, reduce the quality of project implementation and delay completion of projects.

Effects on Local Administration Budget Performance

It was reported in both Zambia and Uganda that there are financial implications associated with increased mortality as a result of AIDS. In the DDSP districts, for example, the administration has included within its budget a component for treating staff, making burial arrangements, and purchasing coffins. However, because of rising staff demand for these funds (when staff or their dependants fall sick), the budget is grossly insufficient and cannot be accessed by staff beyond the district level. The lack of effective medical and life insurance policies for staff, especially as related to HIV/AIDS, increases the pressure on individual staff members.

And not only is the demand for resources high, AIDS morbidity and mortality reduces the revenue base for localities. Because mostly adult males die, the tax base in several districts in Uganda is threatened by the loss of taxpayers and by the declining production capacity of the survivors who devote more and more income and time caring for the sick and dealing with the needs of their extended families.

In the long run, this situation will reduce the ability of the stakeholders to meet obligations like counterpart funding and implementation of activities that require community participation and the labor of adults. This is another issue that retards the completion of projects.

Effects on Household Farm Production

The response initiatives, levels of awareness, quality, and extent of AIDS programs and activities in different countries are so diverse that selecting specific entry points for AIDS effect mitigation is difficult. Therefore although an effective response mechanism may not be applicable to all settings, the broad suggestions below can form benchmarks for policy and program options.

Labor Supply, Skills, and Management

At the farm household level, productivity is affected mainly through labor supply. The ill health and death of family members and the demand for patient care decrease the labor available for agricultural production. Associated with this is the household's loss of experienced farmers and farm management skills due to death, ill health, or nursing care demands. Owing to shortage of food in the HIV/AIDS-affected families, some children and adults may have to labor directly for food, which shifts attention away from their own farm production.

Farm Inputs

Declining investment in agriculture at household level is another effect of AIDS. Not only does AIDS reduce production, and hence the surplus available for sale, but even the little income that might have been spent on inputs (fertilizers, tools, herbicides, transport, and other equipment) has to be diverted to the family's immediate needs of medical care and nutritional supplements for the patients or to purchasing food for the family due to AIDS-related food insecurity.

One alternative source of investment in agriculture is accessing credit. However credit institutions often are reluctant to lend to HIV/AIDS-affected families. These families are perceived to have relatively higher risk of default: borrowers might die or the resources might have to be diverted to patient care. The Uganda Women's Effort to Save Orphans (UWESO) savings and credit scheme, one of the best examples of lending to orphan-care homes, ironically is reluctant to lend money directly for agricultural production, which it considers a high risk investment. UWESO encourages its clients, many of who are from HIV/AIDS-affected households, to borrow for quick-income trading projects. The organization only reaches out to agricultural production enhancement through training in improved production techniques and encouraging the use of the clients' personal savings (but not loan money) for farm investment.

Property Rights, Access to Land, and Land Fragmentation

The saying, "HIV/AIDS issues are gender issues," comes sharply into focus in considering property rights, access to land, and land fragmentation. HIV/AIDS affects security of tenure of land. When the head of household dies, inheritance and property-sharing challenges arise. Land may be subdivided into small fragments that are economically nonproductive even for subsistence. In many instances widows who are experienced in managing the land are expelled by property-grabbing relatives of the deceased husband. In instances when the husband and wife both die, the relatives may be much less interested in the care and up-bringing of the orphans than in taking over the land and other property of the deceased. The family's farm productivity is also threatened when land is sold off to meet the medical expenses of sick household members.

Marketing of Farm Produce

HIV/AIDS affects marketing of agricultural products in three main ways. First, HIV/AIDS-affected households may be unable to get an adult to travel to local

markets or to more lucrative markets further away. Second, owing to the low production, coupled with poor transport networks, areas highly affected by HIV/AIDS are unable to attract many traders directly. Consequently produce must be sold through middlemen who often undercut farmers. Third, people's purchasing power is reduced because of declining disposable income, hence local market are very poor.

Changes in Farm Enterprises

With increased labor deficits, AIDS-affected families are often compelled to shift toward crops that have low labor and capital input requirements. They switch from growing cash crops to more subsistence practices and from long-maturing (and sometimes more nutritious) crops to quick-maturing crops. Many families are also forced to sell their livestock to meet food, medical, and funeral costs.

Rationale for HIV/AIDS Mitigation in Agriculture

Most projects and programs are or soon will be suffering from the effects of the epidemic. This is the rationale for projects joining efforts to prevent HIV and mitigate AIDS effects. If project operations involve other key players (or potential partners), handling the effects of HIV/AIDS and related work, their role, and its real or possible effect on HIV/AIDS concerns need clarification.

A clear examination of the rationale for or against integrating all AIDS prevention strategies will help in defining specific targets for mitigation. In addition there is a need to explain the nature of intervention. For instance, would the project have to undertake prevention as well as mitigation activities? Or would it concentrate on just one? For projects that are likely not to carry out any HIV/AIDS activities, it will also be necessary to clarify why HIV/AIDS prevention and mitigation or other activities should not be included within the work of the project or program.

One cross-cutting factor seems to be that measures to strengthen the production capacity of HIV/AIDS-affected families, caregivers, groups, communities, and individuals are critical for the survival of HIV/AIDS-affected families. Yet mitigation measures alone might be difficult to initiate where the level of awareness of HIV/AIDS and its prevention is still very low, as is openness about the epidemic. Furthermore even in areas where awareness is higher, the need to move beyond HIV/AIDS prevention to sustainable development is seldom widely understood. And where that concept has been accepted in general, the multi-sectoral approach to managing HIV/AIDS remains a challenge in engaging development workers to ensure sustainable production and care for HIV/AIDS-affected households.

Entry Points for HIV/AIDS Mitigation

Before attempting to integrate mitigation activities in on-going programs or new program designs, some key questions must be addressed.

1. What types of activities are under way, and what is the effect of HIV/AIDS on them and vice versa?

2. Why is there a need to integrate mitigation activities, and what kind of activities are to be integrated?

3. What are the cost implications of integration for projects, and who will bear them? Would HIV/AIDS effects substantially change the expected benefits of the projects? How do the costs (economic and social) of the losses resulting from failure to mitigate AIDS effects relate to the financial costs of mechanisms for mitigation?

4. What other implications are likely if the effect of HIV/AIDS on the projects (for instance, issues to do with sustainability and

long-term poverty reduction or eradication) is not taken into account ?

5. Who will be responsible for integrating HIV/AIDS mitigation and other activities in on-going project activities, and what capacities do they have or need to do this effectively? Is such capacity readily available, or can it be acquired within a reasonable time and with reasonable means?

The sections that follow suggest entry points through which the issue of HIV/AIDS effect mitigation can be approached in different countries. The list is by no means exhaustive. It is a starting point for identifying feasible mechanisms for different approaches to integrating the mitigation of HIV/AIDS in projects or program work.

Aside from differences among countries in recognition of AIDS as a multisectoral issue, national approaches and agricultural development projects themselves differ in quantity and capability of human resources, the orientation of these resource to HIV/AIDS mitigation work, and the existence of individuals with pragmatic skills in planning for mitigation. A second difference is receptiveness to allowing HIV/AIDS mitigation work to be integrated with existing development project objectives and activities. A third difference is the degree of recognition of the value that activities for preventing HIV and mitigating the effects of AIDS will add to attaining the objectives of development projects or set goals for development. Finally projects differ in their access to resources (human and financial) for HIV/AIDS effect mitigation.

Strengthening Nongovernmental Organizations

In some countries HIV/AIDS mitigation might be approached through an umbrella organization. Such an organization would coordinate the efforts of government, NGOs, districts, and communities to mainstream HIV/AIDS mitigation into their work. Where such an organization is already handling some aspects of managing HIV/AIDS, the orientation toward mitigating the effects of HIV/AIDS is likely to be easy. Examples include the AIDS Support Organization of Uganda, the Network of Zambian People Living with HIV/AIDS, Agency for Cooperation and Research in Development (ACORD), and several religious bodies.

ACORD approaches mitigation of HIV/AIDS effects at the family level by encouraging the formation of parish orphan carers' associations and improving their management skills. Membership in an orphan carers' association gives individual orphan care families access to ACORD's micro-savings operations, which lends at low interest rates (1.5% per month).

Mitigation in the Absence of Strong HIV/AIDS Organizations

IFAD (2001) found that although HIV/AIDS has had devastating effects on many rural communities in eastern and southern Africa for over a decade, few mechanisms deal with the negative effects of the epidemic. The countries of the region seem to have evolved strategies for effective prevention and palliative care, but little for maintaining the production potential of HIV/AIDS-affected families.

Even in areas where micro-savings organizations do not exist, there may be other community organizations with outreach structures such as seed multiplication, crop diversification, farm mechanization, or agricultural financing that can be enabled to create capacity for HIV/AIDS prevention and mitigation. Activities can range from such peripheral work as distributing information, education, and communication materials as part of normal extension service delivery to involving or targeting orphans or HIV/AIDS-affected families in normal project activities. In

Zambia, the Programme Against Malnutrition and the Smallholder Enterprise and Marketing Programme both provide useful structures that could be used to introduce the mitigation of HIV/AIDS.

Such adaptability requires a flexible program or project design that permits integrating HIV/AIDS prevention, care, and mitigation activities. Unfortunately many projects that depend on donor funds lack flexibility, and unless there is a strong demand from the beneficiaries this may not be immediately feasible.

Integrating Mitigation into the Project Development Cycle

Ideally, integrating HIV/AIDS mitigation activities should be done in project formulation stage. Various stakeholders could be brought into planning and identifying mitigation strategies by focusing on the various aspects of production as related to HIV/AIDS and by demonstrating the effects of HIV/AIDS on communities and their livelihoods and on the proposed interventions.

During the planning and development of new projects, HIV/AIDS mitigation activities should be built into some or all of the project components. They need not emerge as separate or additional tasks. However it is vital to keep in mind that planning is part of a process to facilitate operations.

Programs should avoid becoming bogged down in policy and planning for integration of HIV/AIDS instead of mobilizing resources and launching operations. Formulation and appraisal documents, however, should clearly spell out implementation modalities of any recommended HIV/AIDS-related activities including training. Financial and human resource requirements are an essential part of this. Indicators of achievement for integration of HIV/AIDS mitigation and related activities should also be part of the project documentation.

It is important to note that although most standard project preparation procedures call for baseline surveys, HIV/AIDS is rarely emphasized at the baseline stage or during the formative stage of projects. Baseline assessments should examine the possible effects of HIV/AIDS on the project, on-going activities in HIV/AIDS prevention and mitigation, and the key partners in this field. Such preparatory activities should also determine the policy environment as relates to HIV/AIDS and the community's perception of the effect of the epidemic on their livelihoods, along with ongoing and potential community mitigation strategies.

NGOs could be brought in at this stage, thereby drawing upon their experience in HIV/AIDS and community development. The resulting detailed analysis should then be the basis of interventions developed as part of the project. Using this analysis at the beginning of program development will ensure that HIV/AIDS mitigation activities are fully integrated in the project and are not seen as an add-on component.

During needs identification (socio-economic production systems surveys), the implications of the project for HIV/AIDS infection prevention or effect mitigation should be established. Participatory techniques that involve the beneficiary population in carrying out risk assessment and means of preventing HIV/AIDS are likely to have a double benefit for prevention and impact mitigation. The assessment teams should include community members to identify prevention and mitigation strategies. Such activities will include the determination of "education" stages and messages as the project is being implemented. For example, what kind of messages need to be given to the beneficiaries before and during implementation?

For on-going projects, alternative entry

points can be considered with the various stakeholders either individually or in combination.

Project-wide AIDS Studies

Carrying out carefully designed studies of the project-wide effect of HIV/AIDS and its mitigation, preferably including participatory techniques with all stakeholders (such as government, project managers, extension staff, beneficiaries, associated groups) will have a cost, but they can result in better returns. Such studies can also provide useful benchmarks for fully integrating prevention and mitigation activities in subsequent project cycles. Or they can help to establish a warning system for program sustainability if the project phases out.

Management and Staff Sensitization

Identification of AIDS effects and integration of HIV/AIDS mitigation activities in components of on-going project activities can be carried out with management and staff. This approach has the following minimum requirements:

1. Educating key actors, especially the head of the component implementation, to be part of the integration processes.

2. Creating and maintaining the interest of key players in integrating HIV/AIDS in their work. If they lack interest or are in doubt, they will not integrate the activities.

3. Equipping the component manager with the skills, resources, and means of effecting the integration.

This approach is relatively cheap and can be used as a build-on process for HIV/AIDS-responsive project interventions in development and poverty eradication. However, to avoid losing the integration, several questions need to be considered:

1. What elements of HIV/AIDS are going to be integrated in each component of the on-going program?

2. Who should be targeted in effecting the implementation and how?

3. Why is it necessary to integrate? Of what benefit will integrating HIV/AIDS be to the component?

4. How is the integration going to be carried out? What mechanisms will be used, what resources will be needed, and what time schedules will be followed?

Working with AIDS-focused NGOs

Where program staff have difficulties in effecting integration of HIV/AIDS, cooperation can be arranged with NGOs that have demonstrated skills in integrating HIV/AIDS mitigation. Many NGOs have developed effective programs especially for preventing infection and working with persons or families that are affected by HIV/AIDS. In Uganda's District Development Support Programme, for example, the districts could contract NGOs to integrate HIV/AIDS activities with similar approaches being adopted to those of credit management. Under such an arrangement, government (districts) would be responsible for supervision and might provide staff to understudy the NGOs' work for sustainability of effort and mutual capacity building. The NGOs would also benefit from the government extension network.

Focusing on Specific Activities within Projects

Many of the numerous challenges that face households affected by HIV/AIDS are closely interrelated. The critical challenges however relate to management of households and household productivity; on-farm and off-farm labor; health of HIV/AIDS-affected persons, caregivers, and all household members; and most critically, household income and expenditure. No single intervention program is likely to address all these equally, but addressing one directly may lead to multiplier effects that

will provide long-term answers to many of the rest. At present, the lessons of coping with HIV/AIDS that have a substantial effect on overall household well-being and poverty alleviation remain limited.

Learning from Affected Families and Communities

Currently, few best practices for sustaining household productivity and income amidst the challenges poised by HIV/AIDS have been documented. Yet many households and communities have continued to evolve coping strategies of their own, such as:

- selling labor for food
- shifting from labor-intensive production to less labor-intensive crops
- commercializing the traditional subsistence economy (for example, selling of household food or domestic animals)
- rearing domestic animals such as poultry and pigs for sale
- rearranging household responsibilities and labor division to compensate for adult labor deficits
- sharing orphans and responsibilities among surviving adults
- setting up communal burial groups and community-based welfare organizations

Because different rural communities have distinct lifestyles (such as crop farming, fisheries, herding, or trading) and because, in a unique way, they are adopting to the epidemic, each community can be regarded as having a wealth of experience. Together, their experiences can be a powerful weapon for mitigating the effects of HIV/AIDS.

The challenge for sector workers, program managers, and staff working with the projects is to identify the best practices in families and communities that are cross-cutting and then to bring out the best practices, identify the challenges, copy lessons, and enable the families and communities affected by the epidemic to move on together with the other families in all development endeavors.

The enormous burden of caring for HIV/AIDS-affected families demands that multiple players join in the mitigation exercise. A coordinated and concerted effort of all change agents in mitigating the effects of HIV/AIDS at the household level is urgently needed. Religious organizations, NGOs, and institutions experienced in working among vulnerable groups are the best starting points. UNAIDS could usefully document such efforts, coordinate their work (enabling them to share experiences), and highlight the best practices.

Using Evaluation and Research as an Entry Point

In line with the above, poverty eradication and development stakeholders could consider building an awareness of community-based response to HIV/AIDS into all their programs through evaluation studies and other research support. The strengths and weaknesses of community initiatives and their benefits for the different subgroups within the communities (like children, women, and grandparents of HIV/AIDS-affected people) need to be documented, with gaps identified and responded to quickly. It is worth noting that evaluations in rural development programs (including project formulation missions) that fail to give specific recognition to HIV/AIDS-affected families (or such other groups as grandparent-headed homes, orphan-care homes, and female-headed households) will probably mask the realities on the ground.

Capacity Building

All the above will call for:

1. Identifying and building capacity to enable sectoral workers to study, implement, and document the best practices for alleviating the plight of epidemic-hit families and caregivers.

2. Adopting replicable methods for community studies and for developing strategies for epidemic-affected households.

The main obstacle to integrating mitigation of HIV/AIDS effects in on-going project work is that it requires critical changes in thinking and planning. Many programs may simply resort to slogans such as "HIV/AIDS is not just a health issue but an integral part of development" or "We need to mainstream HIV/AIDS mitigation into our work" without adequate identification of the modalities and sufficient commitment of resources to support the slogans. Even after modalities have been identified, full integration of HIV/AIDS mitigation activities will require conviction, elimination of fears and stigma, and full commitment by managers and staff of the projects. Such changes cannot happen overnight and may not be fully realized within the remainder of the project cycle, but a start is essential.

Strength of National HIV/AIDS Program and NGO activities

Sub-Saharan countries are at different stages in their perception of the impact of the HIV/AIDS crisis on their development. Some countries maintain that HIV/AIDS poses no serious threat to them, some have recognized the threat of HIV/AIDS for over 15 years, and some have accepted HIV/AIDS but have made no serious efforts to curb it. Where HIV/AIDS programs have long been in place, the emphasis has usually been on preventing its spread and to an extent on palliative care for persons living with HIV/AIDS. Little work has been done on mitigating the effects through sustaining household productivity.

Managing the effects of HIV/AIDS requires political commitment at the highest level. In Uganda, for example, although the government's early realization and open admission of the seriousness of the epidemic may have helped to stabilize prevalence rates, there is still need for a campaign to mitigate the effects of the epidemic on family production, income, and expenditure patterns. In such a campaign, each country must mobilize every sector of the community not only to carry out infection-prevention activities, but also to provide remedies for household self-support and community care even in the worst-case scenario of multiple adult deaths.

Although many persons face multiple crises arising from HIV/AIDS affliction, there are few coordinated efforts to deal with them. Managing the effects of HIV/AIDS is largely an individual family affair. When the family fails to cope, and no other extended family member is available to lend a helping hand, destitution sets in. Consequently the management of HIV/AIDS effects has not yet become the concern of many programs, and where it has, the concern has generally been limited to analysis of the effects and an expression of concern.

Poverty alleviation and development programs are critical for managing the effects of HIV/AIDS at all levels. In this regard partnership and coordinating activities with and among donors, civil society, local governments, and community-based organizations will go a long way toward ensuring effective management of the effects of HIV/AIDS.

Joint Prevention, Sensitization, and Mitigation Activities

Some projects will require a strong component of sensitization about HIV/AIDS, prevention, and mitigation of the effects on production. Where strong partnerships in prevention and palliative care exist, partnerships roles should be reexamined to ensure that at least one of the partners is stressing mitigation of the effects of the epidemic on the project components. Moreover, there is no reason why mitigation

work cannot incorporate prevention messages and activities as has been done with Uganda Women's Effort to Save Orphans and other NGOs like ACORD, ActionAid, and World Vision in Uganda.

Handling Stigma in Targeting Affected Families

Care should be taken to avoid stigmatizing affected families. One way is to mobilize such families through the use of disadvantaged groups' identification mechanisms. Another is the use of village headmen to identify the vulnerable groups (orphans, widows, and other HIV/AIDS-affected groups) who will be charged with ensuring that whatever intervention is in place caters to these marginalized families.

Individual and Household Contributions to Project Support

Some donor and government-supported programs demand contributions from households before they can be fully involved in the program. The danger is that an inflexible requirement for labor and monetary contributions is likely to eliminate the most needy households among which many HIV/AIDS-affected families fall.

Conclusion

The HIV/AIDS epidemic poises an extra challenge to development efforts in sub-Saharan Africa. However, there are various entry points through which the mitigation of HIV/AIDS effects can be integrated with ongoing activities in agriculture and rural development. It is becoming clear that such opportunities need to be identified since the solutions offered in managing the effects of HIV/AIDS may be the only possible long-term solution to challenges of development in families and communities heavily affected by HIV/AIDS.

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