

IMPLEMENTATION OF AGRICULTURAL TECHNOLOGY TRANSFER AND DEVELOPMENT IN TANZANIA: SHARING EXPERIENCES AND PROGRESS

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ABSTRACT

The Food and Agriculture Organization of the United Nations (FAO) is extensively involved in the promotion of development and technology transfer in developing countries. FAO assistance includes support for training; the planning and administration of research; technology assessment; and the collection of basic data. It promotes links between national, regional and international research institutes and organizations. This paper describes FAO's approach to development, and illustrates this with some of the many FAO-assisted projects underway in Tanzania.

INTRODUCTION

It is a matter of great honour and pleasure for me to be with you at this Conference on Agricultural Research Training and Technology Transfer in the Southern Highlands of Tanzania organized by Uyole Agricultural Centre in conjunction with the Ministry of Agriculture, the Finnish International Development Agency (FINNIDA), the Danish International Development Agency (DANIDA) and the European Economic Community (EEC). I, on my own and on behalf of the Food and Agriculture Organization of the United Nations (FAO) Dar es Salaam, would like to express our profound gratitude to the FINNIDA-Uyole Agricultural Centre (UAC) Support Programme for giving us this opportunity to give a presentation of FAO's experience in agricultural technology transfer and development in Tanzania. Before I proceed to speak on today's topic, allow me to congratulate and compliment the organizers of the conference for creating such an immaculate and congenial environment in this venue, facilitating the constructive and extensive exchange of thoughts, ideas, experiences and expertise on some vitally significant issues concerning agricultural research, development and technology transfer.

Some developing countries have achieved remarkable growth rates in the agriculture sector and laid the foundations for sustainable economic development. Others are still endeavouring to bring agriculture on to a point where it can feed the ever increasing population and free the country from the shackles of poverty and malnutrition. There are still others who, it seems, are perpetually involved in facing the scourges of famine, starvation and hunger. The reasons are many and varied. Much remains to be done in improving technologies, modernizing obsolete structures, reviewing the nascent will of the resource poor farmer and, more importantly, integrating the smallholder farmer into the mainstream development process. If success is to be achieved on a broad front, it will be necessary to upgrade and revitalize the entire system of agricultural research and technology development. Indeed the acceleration of the growth rate of agriculture sector, its transformation from subsistence to a commercially viable activity, and its diversification, depend on the development, adoption and spread of modern agricultural technology.

Technology is the knowledge and package of tools and techniques that can be used to make maximum use, in the most efficient manner, of our endowments in the terms of the environment and people to allow us to satisfy our needs.

In recent decades, technology development and transfer have been characterized by what is called appropriate or intermediate technology, which focuses primarily on the orientation of technology to the needs of majority, and to the employment of available natural resources, capital and labour in a sustainable manner. This allows the community to own, control, operate and maintain technology,

enhances the skills and dignity of the users, and is socially, economically and environmentally sustainable. The quintessence of such technology is that it is small, cheap, simple and non-disrupting. However, technology should not be conceived of or perceived as a neutral entity. Its success or failure primarily hinges on the extent to which consideration is given to such issues as who will use it, and how and why it will be used, in its development and application. It is this anthropological perspective which should determine the viability and sustainability of the technological choices that a country pursues. Unfortunately, in our scholastic and scientific quest to expand the frontiers of knowledge and technological excellence, we relegate these considerations to the periphery.

ELEMENTS OF TECHNOLOGY DEVELOPMENT AND TRANSFER

With these introductory remarks, I would now like to dwell briefly on the role of FAO in research and technology development and transfer in the field of agriculture. It needs to be borne in mind at the outset that FAO itself is not a research organization. However, through its activities and collaborative arrangements at the international, regional and national levels, FAO is extensively involved in the promotion of development and the transfer of technology, to enable developing countries, such as Tanzania, to share and participate in the research/technology experience and progress.

The main elements of the FAO participatory and collaborative effort in the development and transfer of technology are as follows:

- The strengthening of research management capabilities by improving the management skills of research leaders in developing countries by means of training courses, workshops and related training material figure prominently in FAO's work. The research managers, trained by FAO in collaboration with research organizations and donor agencies, are encouraged to disseminate their acquired knowledge in the countries concerned through national courses for which FAO provides the necessary logistical and technical support.
- The Research Review Missions and Advisory Services of FAO, upon request from member countries, assist governments in the overall planning, organization, administration and evaluation of national research.
- The specific technology assessment and transfer element of FAO's work functions within a farming systems context, to evaluate problems with the adoption of specific technologies and identify related socio-economic constraints. Special emphasis is given to traditional technologies and their use by farmers, and to the role of women in the application of agricultural technology. Assistance is also provided to member countries in appraising new technologies, especially biotechnology, and in formulating policies and strategies.
- The research policy, planning and information services of FAO help member countries to access basic data on agricultural research and research systems.
- Science and technology co-ordination covers FAO's contribution to, and feedback from other bodies of the United Nations and specialized agencies active in science and technology for development.
- Last but not least, and perhaps of tremendous significance for the international and regional collaborative effort, FAO supports international agricultural research by collaborating and liaising with the international agricultural research centres (IARCs), international regional groups concerned with agricultural research (including the World Bank's Special Programmes for African Agricultural Research, SPAAR), the organization for Economic Co-operation and Development (OECD), the European Economic Community (EEC), and other international organizations. FAO's

contribution to the Secretariat of the Technical Advisory Committee of the Consultative Group on International Agricultural Research (CGIAR) represents a major part of the allocation. These bodies are involved in the development of new techniques and technologies all over the world.

APPROACHES TO TECHNOLOGY DEVELOPMENT AND TRANSFER

These elements of technology development and transfer are channelled to the member countries by means of the following broad approaches.

The participatory approach

The fundamental aim of FAO's approach is to induce and encourage close partnership between FAO and the government of national organizations concerned. This involves using a 'bottom-up' participatory approach, which envisages the active and full involvement of the beneficiary users of the technology. This is the key feature of FAO-assisted projects, which takes into account at the design stage the paramount need to incorporate people's perceptions, preferences and responses to new technology. FAO makes strenuous efforts to ensure that the technology it seeks to promote is not contrary to traditional norms and behaviours and the symbiotic relationship of the people with nature and the environment. In Tanzania, FAO is assisting the Government to develop capabilities in animating and activating the farmers and people to meet their food needs, and to assign priorities in the planning and implementation processes to reduce the gap between planned and attained objectives.

The Co-operative College at Moshi is the hub of FAO activities in the participatory approach activities which we have been advocating over the years. Our projects GCP/URT/080/NET and TCP/URT/2252 (T) are laying down solid foundations for emulating and popularizing this approach to development. We feel that the development and adaptation of technology has to be geared to the people's actual needs which alone would contribute enormously in accelerating the process of transfer, adoption and application of technology in the country.

Sustainable agricultural development

FAO has played a pioneering role in sensitizing the world community and national governments to the need to pursue sustainable agricultural development. The rapid increase in population, coupled with the accelerated and unbridled pace of technological progress, pose an ominous threat to the symbiosis between agriculture and natural endowments. FAO has assiduously pursued the ultimate goal of ensuring food security and improving the living conditions of the rural population while simultaneously fostering the conservation of natural resources and the protection of the environment. The equilibrium of the eco-system and the productivity and regenerative capacity of natural resources have to be maintained by embracing principles and strategies that harmonize with people, nature and technology. This could be achieved sooner if we could design institutional and technological change in such a manner as to ensure the satisfaction of our needs for the present without jeopardizing those of the future.

Technical co-operation among developing countries

The Technical Co-operation among Developing countries (TCDC) programme is a strong vehicle for fostering technological progress in developing countries and is at the centre of FAO's efforts to boost and encourage co-operative and collaborative action among developing countries. I therefore propose to discuss this aspect in greater detail.

The high costs of the modern and sophisticated technology used in the developed world, coupled with the unjustifiable costs associated with the aid dependency syndrome, are characteristic of donor driven technology. This makes TCDC critically important to the development of agriculture in the third world. The fundamental principle of TCDC is the voluntary sharing of technical resources, skills and capabilities in order collectively to make progress. FAO acts as catalyst by helping member

countries to identify potential areas for co-operation and to implement TCDC activities by sharing expertise and experience. TCDC has the following objectives.

- To promote and strengthen individual and collective self-reliance among developing countries through the exchange of experience, the sharing of technical resources and the development of their complementary capacities.
- To increase the quantity and enhance the quality of international co-operation and the resources devoted to its promotion.
- To strengthen existing technical capacities in developing countries, including the traditional sector, to improve the effectiveness with which such capacities are used and make maximum use of resource endowments; and to create means of transferring this technology to other developing countries.
- To increase and improve communication among developing countries, to promote a wider awareness of common problems, wider access to existing knowledge, and the creation of new knowledge in confronting the problems of development.
- To improve the capacity of developing countries to absorb technology and adapt it to their specific needs.
- To respond to the special needs of the least-developed, the land-locked, the island, the developing and the most seriously affected states.
- To enable developing countries to participate to a greater extent in international economic activities;
- To increase the confidence of developing countries in each other's technical capabilities and to enhance the harmonization of their interests.

There are, however, certain problems which need to be tackled to ensure that TCDC operates at its full potential. These are: the difficulty of quantifying the skills or technologies and the lack of formal mechanism to assist cooperation between/among matching nations; shortages of finances, especially in terms of hard currency; an entrenched tradition of North-South technological dependence.

While basic socio-economic considerations justify the promotion and implementation of TCDC in most if not all technologies, probably no sector is more suited to TCDC than agriculture. The transfer of agricultural technology is much more likely to be successful if it occurs within or between zones with similar ecological conditions, for example a South to South rather than a North to South transfer. This is because the technologies of developed countries are often unsuited to local conditions in developing countries and require a long adaptation period; they are designed for large scale farming and they involve heavy organization and management costs which place unwarranted strains on already over-stretched foreign exchange reserves.

FAO regional projects that involve Tanzania include the Control of Tick and Tick-Borne Disease in East and Central Africa, Pesticide Management, and Fisheries Management/Development.

FAO is also encouraging the use of existing international information systems such as AGRIS and CARIS, which in Tanzania have been established in the Department of Research and Training of the Ministry of Agriculture Livestock Development and Cooperative (MALDC). FAO organizes inter-country consultations and workshops in Tanzania, in East Africa and even further a field. In the first six months of this year (1992), FAO funding enabled Tanzanian delegates to participate in more than 30 workshops and seminars abroad.

The provision of assistance to existing regional organizations is yet another way in which FAO encourages the linking of groups from developed and developing countries to share technical assistance between the participants. The Commission on Animal Trypanosomiasis, for example, links 38 African nations with the result that knowledge of trypanosomiasis immunology has been increased and spread. The Desert Locust Commission and the international fisheries bodies are other examples of the pooling of resources and knowledge in the pursuit of technology development and transfer. Tanzania is an active participant in these activities.

The Desert Locust Control Organization for Eastern Africa (DLCO-EA), comprising Djibouti, Ethiopia, Kenya, Somalia, Sudan, Uganda and Tanzania, has a fleet of 12 aircraft and 250 vehicles equipped for spraying and the transport of insecticide. DLCO-EA is carrying out research to isolate new and more effective insecticides, which includes a testing service to ensure that insecticides are not harmful to people or animals. As a result of these efforts, under the umbrella of the Desert Locust Commission, the risk of plagues of locusts has been drastically reduced and there have been no major threats in recent years.

The Networking systems, which facilitate technical co-operation and information exchange through linkages between national institutions, also serve as a vehicle for technology transfer.

The role of FAO in ensuring that technology from one developing country is transferable to other cooperating countries is particularly important. FAO uses its technical expertise to investigate existing technologies and determine how they can be made acceptable and more efficient in a wide range of socio-ecological conditions.

FAO IN TANZANIA

I now turn to FAOs specific contribution to Tanzania. Among the various modes of promoting technology development and transfer and sharing experience and expertise in Tanzania, FAO has provided its assistance primarily through the following mechanisms.

Institutional support

FAO provides assistance to research institutions and Government laboratories to enable them to upgrade their capability to undertake development activities. In recent years, under the National Seed Project, a horticultural complex has been established at Tengeru with the full participation of national counterpart staff. This is capable of providing training to both the public and private sector on the production and processing of fruit and vegetable seeds.

The Tsetse and Trypanosomiasis Research Institute in Tanga, in collaboration with the Department of Livestock Development in Zanzibar and with technical assistance from FAO, has established an in-vitro mass-rearing facility for the production of sterile male flies.

FAO has also provided assistance to the Government to enable it to monitor marine pollution along the coast by supplying sophisticated laboratory equipment and chemicals and training for local staff.

The Food Security Department of MALDC has been provided with the necessary technology for crop monitoring and with assistance in carrying out drought-related operations. Tanzanian experts have been given the opportunity to become acquainted with the latest technologies in remote sensing and other early warning systems.

The FAO Regional Project, Veterinary Vaccine Production in Africa, is yet another example of the sharing of technology in the regional context. The aim is to enable the Veterinary Laboratory at Temeke to adopt good manufacturing practice.

Another project involves assisting the Statistical Unit in the Fisheries Division of the Ministry of Tourism, Natural Resources and Environment to establish a statistical system capable of generating the biological, economic and social statistics needed for fisheries development and management. In addition to surveys on Lakes Victoria, Tanganyika, Nyasa and Rukwa, and the sea coast, the project involves streamlining information dissemination by enhancing the capabilities of the automatic data

processing systems and by staff training on new tools and techniques for data processing, analysis and interpretation.

Constraints to enhanced agricultural production are due partly to the farm practices and technologies being used. FAO in its projects has therefore placed great emphasis on the establishment of agricultural extension and research systems to provide appropriate new techniques and technology to farmers. FAO-sponsored extension activities are based on the participatory approach, which encourages discussion between farmers and extension agents. Indeed, extension plays a prominent part in many FAO-assisted projects. In Zanzibar, the Comprehensive Agricultural Extension Systems programme not only stresses the participatory approach but also aims to unify and strengthen the extension services at all levels.

FAOs' research activities in Tanzania are mostly integrated in projects with multi-purposes objectives. Examples are the fertilizer trials within the fertilizer programme, and the rice varieties trials within the irrigation projects. However, some projects are concerned wholly or principally with research, for example the formulation of an Agricultural Research Plan for Zanzibar, and the Farming systems Programme.

Training and staff development

The development of new technologies and innovations, and the adaptation of modern sophisticated ~~technology to local conditions depend on the expertise available in the country.~~ FAO has played a leading role in upgrading the skills and expertise of Tanzanian officials through its project-related training activities and training courses organized under a regular fellowship programme. Almost all the current FAO-assisted projects (62) have a strong training component, ranging from doctorate level training to on-the-job short courses. This investment, by providing well trained and skilled people, contributes significantly to enhanced technology innovation and transfer. Trained staff provide a better input to the policy process in general and to decision-making on technological issues in particular. As an example of FAO's contribution in this field, last year, FAO sponsorship enabled Tanzanian participation in 19 technical workshops, 36 training courses and seminars and 24 fellowships and/or expert consultations abroad. Over the same period FAO also sponsored numerous in-country consultations, workshops and seminars.

Development and promotion of specific technological packages

FAO, both on its own and in conjunction with its development partners within and outside the UN, through field research and demonstration, has been able to develop and propose specific technological packages for increasing agriculture and livestock production.

In crop production, the input package of fertilizer, seed and pesticide, coupled with good water management, has been the main technology promoted by FAO in Tanzania. Planning and policy aspects, food security and nutrition, livestock research and extension, post-harvest storage and marketing, natural resource management, fisheries and forestry have also received attention. As a result, the agriculture and livestock sectors are now in a much better position to explore new technological interventions in order to achieving sustainable agricultural development and food security. The following examples illustrate FAO's contribution to the technology development and transfer process.

Seed. FAO is supporting the Government's development efforts in the area of quality seed production. Under the Development of National Seed Production project, which is widely acclaimed a success, the seed production centres have been equipped with machinery, farm equipment and implements, and processing plant. Maize hybrid germplasm has been collected, preserved and characterized seven inbred lines, A, D, F, G, K205, K230 and E250, and one population, Q573 constituted of hybrids of 614, 632, 622 and 6302, purified and maintained. Production of good quality fruit and vegetable seed is also a strong component of the seed programme. Breeder seed and foundation/basic seed has been produced for multiplication purposes. Two centres have been established, one at Horti-Tengeru and one at Dakawa, the existing laboratory of (TOSCA) has been

renovated, and new laboratories have been set up in Njombe, and in Bambi in Zanzibar. Over 200 national staff have been trained in various seed technology disciplines, six national courses and seminars in seed technology have been conducted, five MSc fellowship in seed production awarded, 12 overseas courses and workshops in seed-related fields completed and two study tours accomplished. This project is a good illustration of the various mechanisms employed by FAO for the development and transfer of technology. In the light of the achievements of this project, preparations are underway to launch a new phase to further enhance the seed production capability of the Government. The emphasis in this phase will be on involving the private sector in seed production and marketing. The progress that has already been made in the adoption of new technologies for the production of hybrid maize, and fruit and vegetable seed is commendable and the fact that the Government seems fully prepared to carry on these activities, and rely less on foreign experts, is a good sign for the future development of national technological capabilities.

Fertilizer. The objectives of FAO's fertilizer programmes in Tanzania are, amongst other things to contribute to the adoption by farmers of recommended levels of fertilizer use and to establish an effective fertilizer and related input distribution system, with emphasis on a National Farm Service Centre Network. The main activities of the programme are trials to refine existing recommendations, plot demonstrations on farmers' fields and training for extension staff. Three particularly important involve trials and demonstrations of fertilizer rates, types and application methods, including integrated plant nutrition systems to establish the optimal levels of fertilizer for major food crops such as maize, beans, rice, wheat and sorghum, and for cash crops such as sunflower and groundnuts. The distinctive feature of this programme is its consultative, interactive and participatory approach, involving the expatriates, national experts and farmers to ensure the technological package developed reflects the needs of the people and is appropriate for the soil-specific agro-ecological conditions of each area. Training is provided for the extension staff and farmers, to develop the linkages necessary for the transfer of the technology to the farms. **The project works in close collaboration with the research stations.**

Water. Water constitutes one of the essential components of sustainable agricultural development. Its rational development, utilization and conservation are important for both rainfed agriculture and irrigated crop cultivation, and for livestock, fisheries and forestry. The performance of irrigation projects all over the world is less than expected because of high costs, inadequate operation and maintenance, and a host of socio-economic and environmental problems. Of particular concern is that irrigation can lead to a rapid rise in the groundwater level, causing water logging, salinity problems, depressed crop yields, and water borne-diseases. Water pollution, caused by excess plant nutrients in surface run-off and deep percolation from irrigated and rainfed areas, leads to the eutrophication of surface water bodies and the growth of aquatic weeds and is further sign of poor water management.

With these problems in mind, FAO in Tanzania seeks to promote environmentally - friendly water harvesting and utilization technologies based on traditional irrigation schemes. Three FAO projects, the Development of Usangu Village Irrigation, the Rehabilitation of Traditional Irrigation Kilimanjaro, and the Women in Irrigated Agriculture, provide examples of this approach. FAO focuses its irrigation activities mainly on the smallholder sector, which comprises about 80% of the total irrigated area. FAO accordingly gives a high priority to the rehabilitation and upgrading of traditional irrigation schemes. These projects mainly involve introducing new technology at water intake points, control weirs and intake structures, and improving the efficiency of main canals. They also involve the implementation of improved water distribution and irrigation practices. Environmental concerns such as waterlogging, salinity and the protection of watershed/catchment areas are addressed. There is a strong component of technology transfer in the design, engineering, construction and management of the schemes. The projects involve the active and effective participation of local people, especially in construction and on-farm water management.

In the case of the project Institutional Support to Irrigation Development, FAO is helping to improve the effectiveness of the Irrigation Development by the preparation of Project Planning Design

and Construction Manuals for irrigation schemes. The project also involves the preparation of a draft National Irrigation Programme/Irrigation development strategy for the next 15 years. FAO is proposing water harvesting technology to divert peak floods from rivers onto the fields by means of simple, cheap technology.

In the project Integrated Environmental Protection and Development through Rain Water Harvesting, training has been provided on soil conservation techniques and the construction and operation of rain water harvesting structures for more than 60 farmers in Dodoma.

Plant Protection. In the drive to increase yields there has been a massive increase in the use of agricultural inputs. Pesticides, in particular, have been indiscriminately used, with negative effects on the environment, the health of farmers and costs to consumers. The ecological balance of pest populations has been disturbed and in some cases pests have developed resistance to the pesticides.

There is a need to develop and promote the use of alternative and more sustainable pest control methods, including the use of resistant varieties, cultural practices and biological control, and to use selective pesticides only when the need arises (not as a preventative measure).

The FAO project, Safe and Efficient Use of Pesticides in Africa, Regional Workshop on Pesticides Management, addressed such issues by enabling the pooling of the cumulative experience of countries in the region technologies and techniques that promote the efficient use of pesticides. The FAO project, Migrant Pest Control Management, through DLCO-EA, has helped Tanzania acquire the techniques and technology to control migratory pests, including locusts. Of particular importance in the control of the large grain borer, a serious storage pest in maize, are the FAO Larger Grain Borer Control Training Project, the Assistance to the Field Control of the Large Grain Borer Project, and the Improving Phyto-sanitary Conditions in East and South African Areas at Risk from Large Grain Borer Project. These projects involve the development of regionally acceptable procedures for fumigation, assessment of the effectiveness of insecticide admixtures and sprays in controlling the large grain borer and other storage pests, and the enhancement of the ability at national level to respond to outbreaks and disseminate information on improved storage methods to agricultural experts, farmers, co-operative unions and warehouse personnel. As a result of its effective control techniques, Tanzania has been selected as one of the transit countries in the supply of grain aid, for example in the supply of maize to Zambia and Malawi.

FAO is also supporting Tanzania in the development of integrated pest management techniques. A regional workshop is being organized in Dakar, Senegal, in November this year (1992) to enable the regional countries to exchange views and expertise on the use of integrated pest management in vegetable production.

Storage. Allied to the pest control projects is the FAO project Household Grain Storage Development, which provides assistance for the construction of improved storage structures and the promotion of better management practices. It is hoped that by the time the project ends in 1994, the extension services and farmers will be well equipped to sustain the technology, which is easy and cheap.

Livestock. Animal diseases, especially trypanosomiasis, East Coast fever and tick-borne diseases are a serious threat to livestock development in Tanzania. FAO has introduced new technologies that minimize the dependence on chemicals, which can be harmful to the environment and non-pest species, without reducing the efficiency of disease control. Examples include the release of sterile insects, the development of alternative bait systems for tsetse fly control, and eradication and strategic dipping to control ticks and tick-borne disease.

There are three FAO projects concerned with the eradication of tsetse fly from Zanzibar using environmentally safe technologies. The livestock are all treated at the same time with a persistent pour-on application of a synthetic pyrethroid insecticide, which both attracts the tsetse flies and kills them. In addition, numbers of tsetse fly are being monitored using sticky traps. Tsetse fly has now been successfully eradicated from substantial parts of the island.

The sterile insect technique is being used in Tanzania with the help of the Tsetse and Trypanosomiasis Research Institute (TTRI) in Tanga and the Department of Livestock Development in Zanzibar. TTRI has set up an *in vitro* process for the mass-rearing of sterile male tsetse. The use of sterile tsetse females as sentinel insects for entomological monitoring has also been tested and shown to give valid results. These activities are being undertaken in close collaboration with the International Atomic Energy Agency in Vienna and provide a good example of the value of sharing national international technologies and experiences.

The FAO project, Immunization and Tick Control in Tanzania, currently involves the testing of technology for immunization against East Coast fever. This project is linked to a vaccination production project in Malawi and to work at the International Livestock Research on Animal Diseases (ILRAD) Laboratory in Nairobi. Preliminary results are very encouraging. FAO is also involved in the formation of veterinary clinical and extension services, in consolidating the operation of the Veterinary Investigation Centre, and in arranging training courses for Government officials on laboratory diagnostics and various aspects of animal disease control.

Fisheries. The fisheries sector is the principal supplier of animal protein in Tanzania for those on low incomes and contributes 30% of the total supply of animal protein supply. FAO's support to the fisheries sector is substantial, with three national and eight regional projects currently being implemented.

The project, Integrated Technical Assistance and Credit for Artisan Fishermen, Lake Tanganyika, provides technical assistance and improved fishing equipment to those involved in fishery in particular the women. Training on improved fishing and processing methods is also provided.

The Integrated Fisheries Development in Rural Fishing Villages, Kagera Region, project involves the promotion of more effective fishery techniques, and improved and more environmentally-acceptable fish processing techniques.

The Research for the Management of the Fisheries on Lake Tanganyika project promotes modern scientific research to determine the biological basis of fish production. A long term research programme has been agreed by the four states that border the lake to monitor fish stocks and related environmental parameters, and to provide a basic infrastructure and trained national personnel to allow the research programmes to continue when external assistance ends.

Forestry. FAO encourages the sustainable use of forest resources by promoting traditional or innovative forest-based industrial activity. Non-wood forest products play an important role in the rural household and national economies, supplying food, forage, fuel, medicines, fibres, and biochemicals. Despite their potential importance, non-wood forest products have so far received little attention in forestry research development, investment or planning activities. FAO is helping to identify constraints to the development of non-forest wood products, recommending management techniques and processing technologies. A pilot study is planned in Tanzania to assess the current and potential exploitation of non-wood Forest products. FAO is also supporting Tanzania in the field of forestry technology development and transfer, through the Southern African Development Coordination Committee (SADCC) Forest Industries Training Centre.

CONSTRAINTS

I have given you a brief account of FAO's activities in this country to boost technological advancement. Other donors and aid-giving agencies are also involved in promoting technology development effort either directly or indirectly. However, the potential impact has not yet been fully realized. This is because Tanzania, like many other developing countries faces numerous constraints, which impede the acceleration of the process of technological development and internalization. Broadly speaking, these constraints can be grouped as follows.

- Socio-economic constraints, which find expression in the absence of a maintenance culture, a limited ability to adopt foreign technology or to replace foreign technology with indigenous technology, a lack of investment and human capital, and a lack of mechanisms to integrate traditional elements in national development.
- Institutional constraints, characterized by the absence of effective research and development and the absence of support technological services and facilities.
- Financial constraints, which restrict research and development.
- Organizational and structural constraints, in terms of the dominance of the public sector, supply-driven technological considerations, and lack of private sector participation in the import and internalization of technology through joint ventures or appropriate collaborative arrangements.

SOME KEY ISSUES

Our ability to come up with formulae and technologies to achieve self-sufficiency, self-reliance and food security depends first and foremost on the status of agriculture and of the farmers in our society. Undeniably, in a world beset with the twin problems of a burgeoning population and a diminishing resource base, we are witnessing a situation where erosion is out-pacing erosion control, deforestation is far in excess of the areas being planted with trees, formerly cultivable lands are succumbing to desertification, waterlogging and salinity are affecting huge areas, and food contamination and risk of famine continue to haunt us. We claim to understand the problems to know what needs to be done to overcome them. However, the sad truth is that despite our proclaimed awareness and insight we have failed to eliminate hunger, poverty, deprivation and starvation from our societies. Perhaps we should concentrate more on the symptoms than on the underlying causes.

In our discussions, we need to address ourselves to some of the critical issues and realities that we currently face in Tanzania. Some of these issues are listed below.

- By the year 2010, the population of Tanzania is expected to increase to 41.7 million which means there will be an additional 15-20 million people to feed in a country where malnutrition is prevalent and there is a constant threat of food shortages and drought. Further intensification of agriculture is imperative if we are to feed the population and avoid encroachment onto marginal lands and fragile ecosystems. Agricultural technology must meet the challenge of providing food security, employment and a better income for the people.
- The participation of the people is essential for development and the application of new technology. We need to establish how can we create an economic and policy environment that enables and encourages a participatory 'bottom-up' approach to technology development, or in other words a favourable and all-pervasive technological culture.
- We need to enable people to gain access to improved technologies that permit a more economic and environmentally-acceptable use of natural resources, greater economy and efficiency in the use of energy and renewable resources, and greater use of yield-enhancing technology.
- We need to create, consolidate and strengthen the institutional and human capabilities in tanzania, to foster technological development and innovation within the country and accelerate its application by farmers, by means of developing strong linkages between research, extension and the farmer, and by encouraging the active involvement of the private sector.

- We need to divide technological packages and ensure that they are appropriate for small as well as large scale farmers.
- We need to overcome the institutional and structural constraints which hinder the accessibility of available technology to the small farmer.
- The sophisticated production technology packages of developed countries often involve high costs in terms of the demand on financial resources and implications for the environment and human health. There is a tendency now to incorporate natural processes, such as nutrient recycling, nitrogen fixation, and pest/predator relationships, to reduce the use of off-farm inputs. In developing countries however, even the basic technological input packages of fertilizer, seed, water and pesticides have not yet been widely adopted. This therefore provides a good opportunity for researchers to develop a package based on the experience of traditional farmers, in tune with the production potential of the local environment, affordable by the small farmers.
- It is important to identify the most rational technology for development. This calls for a fresh and objective approach, not one based on concepts of development alien to developing countries. Development should reflect a country's own perception of reality, be responsive to its needs, adapted to the tastes and values of traditional communities, be attuned to the connection between a community and to natural environment, and should not involve complete transformation.
- Research on newly emerging technologies, such as tissue culture, genetic engineering and embryo transfer, offer many opportunities. We need to determine how best we can move into these areas fast enough to realize the benefits.

CONCLUSION

The sad reality is that the gap between the production potential and current production level in Tanzania is so wide that it raises serious questions. Is it that the technology itself is wanting? Is it that the diffusion process is poor? Are the institutions that are meant to serve agriculture providing an inadequate service? Is the capacity of the farming community to absorb new technology limited? Is the polarization of farm size groups too wide to enable the smooth transfer of technology? Or is there some other answer? We need to ponder seriously on these questions. In the process, however, we have to guard against the illusion that ~~economic equality will automatically allow mass technological development is universal~~. After more than four decades of endeavour the developing countries are not yet free from the shackles of famine, hunger and starvation and have little or no hope of emancipation from these scourges. Perhaps we need to scrutinize taken-for-granted assumptions by asking, 'whose technology?' and 'technology for who?'. We should explore the possibility of transforming the entire flow of ideas and tools of technology from supply-driven, donor-dominated to demand-driven, country-specific, needs-based technology. The challenge is considerable and might seem impossible to meet in a period of when economies world-wide are becoming more closely interlinked, and the interests of the poor have been marginalized. However, with will, resolve and collective effort, people and material resources can be marshalled to develop and apply a blend of technology that will ensure food security for all. This may call for institutional reform in the research and extension systems and in credit delivery mechanisms. It may require structural changes in land tenure patterns and the agricultural infra-structure. Above all, it will need changes in the attitudes on the part of the deliverers and recipients of technology, and indeed in responses to the environment.