

Action against undernutrition and poverty

Redirecting food assistance to those who need it most

The World Food Programme (WFP) has launched a new approach to the provision of its assistance. The two essential ingredients of this Enabling Development initiative are closer targeting of specific geographic areas and the underpinning of food aid with rural development activities.

WFP assistance has traditionally been directed to support the development policies of recipient governments or areas judged to be vulnerable to food shortages on the basis of their climate and geography. Typically, food was distributed to regions subject to drought or flooding. Recently, however, a more sophisticated understanding of the causes of inadequate nutrition as well as new tools to gather and analyse data have enabled food-related assistance to be channelled more accurately to the people who most need it. New ways of working at the local level allow beneficiaries to assume ownership of food assistance activities, thereby helping to ensure that the gains achieved are sustained.

The new approach

The new approach recognizes that diverse factors combine to produce different kinds of food insecurity. Recent studies have shown how poverty, illiteracy, malnutrition and environmental degradation can be direct causes, as well as direct effects, of food insecurity. Moreover, although people in areas prone to drought or flooding may be vulnerable to food shortages, as shown in conventional analyses, they have sometimes developed successful strategies for coping with these recurrent threats and so do not necessarily suffer from food insecurity. On the other hand, some disadvantaged members of a community may suffer chronic food insecurity, even in regions where a favourable climate and good soils ensure that there are usually food surpluses.

To achieve food security, three

conditions must be satisfied: food must be available in sufficient quantities, taking into account domestic production, commercial and food aid imports and national stocks; household livelihoods must be adequate to provide people with access to food supplies; and the supplies available must satisfy the specific dietary and health needs of all members of the community.

Vulnerability analysis and mapping (VAM) tools can translate these insights into sound plans and effective action. As part of WFP's strategy to focus its Enabling Development initiative on the most food-insecure areas and people, the VAM Unit, with support from the Canadian Impact Grant Facility, has identified the best practices available for vulnerability analysis. Instead of concentrating on crop failures and other disasters, the new methods can help to identify:

- who is food-insecure or vulnerable to food insecurity;
- why those people are food-insecure or likely to become so;
- where the food-insecure and vulnerable people live.

New country programmes are being designed with more accurate geographic, sectoral and beneficiary targeting. These enable WFP and its partners first to reach the regions and people most in need and then to design and plan activities so as to address the real causes of their food insecurity.

Applying the new approach

A good example of this approach in action is provided by Nepal. WFP was previously involved in two projects in the country: one was in support of a national education programme, and the other entailed the construction and rehabilitation of national rural infrastructure (tracks and trails). When the Nepal Country Office set out to recast its programme in line with the Enabling Development initiative, a major review of

existing projects and a comprehensive vulnerability analysis were carried out. The result was a new programme with the following objectives:

- concentrate resources on areas with the highest incidence of food-insecure people;
- focus on the most insecure populations (the hungry "poor") within these areas;
- carry out activities that address community needs and the root causes of food insecurity.

This line of action means a change in both the areas and the people targeted for assistance. It will shift the focus of WFP activities progressively from the food-producing Terai area of the plains to the western mountains, which have the worst access to food and the most severe food insecurity. Participatory methods will then be used to ensure that the most food-insecure communities, and more specifically households and individuals, will benefit from the employment generated and the assets created by WFP activities.

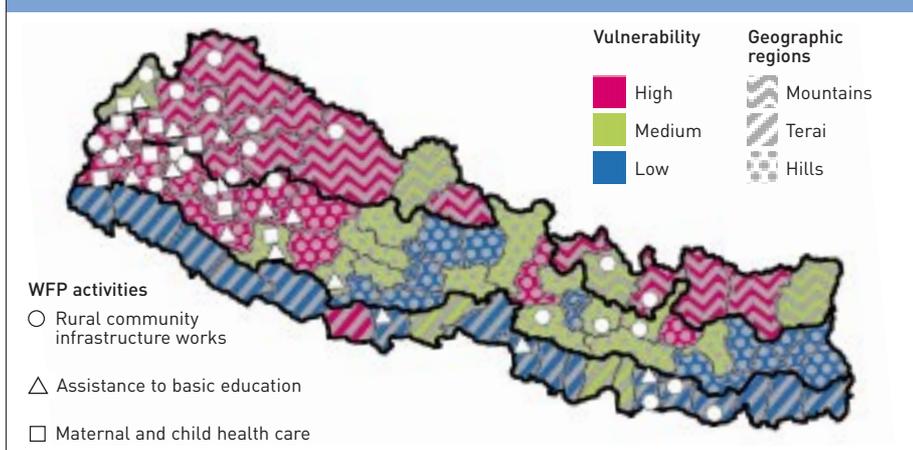
Linked activities

During the next five-year programme (2002-2006), WFP will support three distinct but linked types of activity in infrastructure development, education and nutrition. By concentrating these activities in the same geographic areas, it aims to build up physical and human capital in tandem and so achieve the maximum possible impact on food security.

Initially, the programme will support a range of self-help activities to improve community infrastructure. These will underpin subsequent education and nutrition activities and promote an enabling environment for other development activities. In the short term, the aim is to alleviate temporary and seasonal food shortages in food-deficit households by creating community-based employment. In the longer term,



Figure 15. Vulnerability status of districts in Nepal



alleviating the poverty of households that depend on women's income. Women's representation in local implementation committees should rise from 30 to 50 percent, giving more voice to their needs and opinions.

In the food-for-education activity, WFP will work with Nepal's Primary School Nutritious Food Programme (PSNFP), while the World Health Organization (WHO) will provide technical assistance for a de-worming programme. The PSNFP will also take responsibility, under the new Maternal and Child Health Care activity, for delivering food to the district level, at which point the Village Development Committees take over. WFP will also provide supplementary food, either as a component of the United Nations Children's Fund's (UNICEF's) Decentralized Planning for the Child Programme, or accompanied by technical assistance from the Nepal-German Reproductive Health Project.

Increased effectiveness

As WFP programmes continue to benefit from the more accurate targeting provided by vulnerability analysis, as in the case of the Nepal, so their effectiveness will be increased. Since the Enabling Development initiative was adopted in May 1999, 80 percent of new programmes have benefited from hunger and vulnerability analyses. All development proposals submitted to WFP's Executive Board now include food-assisted interventions designed to enable development in situations where food insecurity is the major constraint. Food aid alone is now used only where extreme poverty prevents access to food. Each improvement in programme planning and execution brings the World Food Summit objectives a little closer to realization.

Vulnerability analysis and mapping as part of FIVIMS

WFP's Vulnerable Analysis and Mapping (VAM) Unit has been a close collaborator with FAO in the interagency Food Insecurity and Vulnerability Information and Mapping Systems (FIVIMS) initiative. While FIVIMS provides guidance on norms and standards for use by national information and mapping systems, the VAM Unit supports the application of these common approaches at the country level.

The stronger the collaborative national information effort, the less need there is for intervening international and bilateral agencies to mount their own information collection efforts. This should prevent duplication and minimize the amount of information needed to support effective operational planning and intervention.

the food security of these households should be improved through the construction of small roads and trails to improve access to markets and through the creation of community assets that stimulate food production. Such assets could include structures for small-scale irrigation or for the control of flooding and soil erosion. Groups of needy households will build the community infrastructure through food-for-work arrangements and will subsequently own and maintain the structures.

The Government of Nepal will provide technical support for these infrastructure works, while the German Agency for Technical Cooperation (GTZ) will provide project planning and monitoring advice as well as training of technical staff. District Development Committees (also trained by GTZ) will approve projects and coordinate local planning. Local NGOs and consultants will help to mobilize groups and train their members. Gender action plans will empower women, enhancing their social status and

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Supplying safe drinking-water for all

Ready access to water that is safe for a range of domestic uses, especially drinking, washing and cooking, is vital for good health and for food security. It is also important for overall economic development. Progress is being made in bringing safe water to rural and urban populations – but there is still a long way to go.

Women in rural Africa and Asia still walk an average distance of 6 km to the nearest water source. This is time that could be spent on more productive or profitable activities such as the family's crop or livestock enterprise. Often, their only source of water is a stagnant seasonal pond, a polluted river or a poorly maintained well. Such sources are often contaminated with germs – bacteria, parasites and viruses – that can cause diarrhoea. Diarrhoea is the major symptom of gastrointestinal infections and is the leading killer of small children in most developing countries. It undermines food security directly, by preventing the body from absorbing nutrients, and indirectly, by sapping people's ability to work and increasing the time and money spent on health care.

Contaminated water is not the only factor implicated in diarrhoea. Inadequate sanitation and hygiene

practices also play an important part. A comprehensive strategy to overcome these three interrelated problems has enormous potential for reducing the burden of disease and thereby contributing to food security in the developing world. The essential elements of such an approach are the provision of more and better-quality water and the introduction of suitably designed hygienic latrines, combined with vigorous and sustained health education programmes at the community level.

The undernutrition-diarrhoea complex

The relationship between undernutrition and diarrhoea can best be characterized as a vicious circle: undernutrition debilitates children and increases both their susceptibility to gastrointestinal infections and the severity and duration of these infections. In turn, the infections undermine their hosts' nutritional and immune status by decreasing appetite and dietary intake, reducing the intestinal absorption of macronutrients and increasing the loss of electrolytes and micronutrients through urine.

Many deaths resulting from diarrhoea are caused by a single bacterium, *Shigella dysenteriae*. Children infected with *Shigella* often suffer from severe, bloody diarrhoea. The transmission of diarrhoea-causing germs, including *Shigella*, occurs by the faecal-oral route. The germs pass from the body of an infected person in their excreta, then later enter the body of an uninfected person through the mouth, either via the water they drink or via the consumption of food contaminated by dirty hands or by cleaning or cooking in dirty water. Water is, therefore, a crucial link in the chain of transmission of the organisms that cause diarrhoea.

The scale of the problem

The undernutrition-diarrhoea complex is among the major causes of childhood

Diarrhoea: one of the world's five big killers

- 1.1 billion people, or one-sixth of the world's population, lack access to safe drinking-water
- 2.4 billion people lack access to any kind of sanitation equipment
- 1 billion episodes of diarrhoea occur annually among children under five in the developing world
- 3 million deaths occur annually as a result of diarrhoeal diseases
- 2.2 million of those who die as a result of diarrhoeal diseases, 90 percent of whom are children, die of diarrhoea associated with inadequate water supply and sanitation

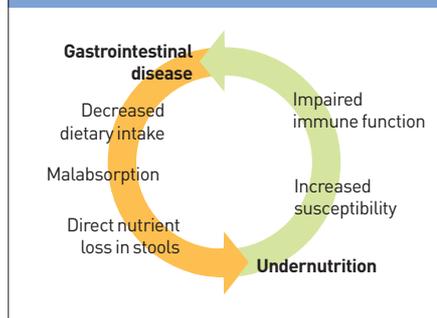
morbidity and mortality in the developing world. Of the nearly 12 million children under the age of five who died in 1995, about 70 percent were affected by one (or more) of just five conditions: malaria, measles, acute respiratory infections, undernutrition and diarrhoea. The death rate among undernourished children suffering from diarrhoea is far higher than among their better nourished counterparts.

Displayed in the Box above are some statistics that describe the links between diarrhoea, mortality and access to safe water and sanitary equipment. They make grim reading. Despite nearly half a century of intensive development efforts by the international community, a combination of population growth and, in some regions, deepening poverty means that the challenges are still far from being met.

Designing interventions

Clearly, considerable improvements could be achieved by intervening to improve food security via improved water

Figure 16. Relationship between gastrointestinal disease and undernutrition





supply and sanitation. The aim of such interventions should be to ensure a sufficient year-round supply of safe water within easy walking distance. To be effective, however, this basic facility must be accompanied by adequate sanitation and personal hygiene practices, both in individual households and in the entire community. Interventions should target the poor, since they bear the greatest burden of water-related diseases. The focus should be on both urban and rural communities, although it is in urban areas that the largest and fastest-growing numbers of people suffering the consequences of unsafe water and inadequate sanitation are to be found.

A comprehensive approach should tackle the underlying causes of diarrhoea-related food insecurity. It may be complemented by the use of oral rehydration therapy (ORT), which has been shown to be a highly effective way of

A potential beneficiary

Eliza Fenlas, mother of three children, lives in Inhambane, one of Mozambique's driest provinces. She spends five hours a day trekking 24 km to fetch 20 litres of water. She looks forward to the day when her area will benefit from a safe water programme, aware that a well near her home would make a big difference to her life. Besides having more readily available water for drinking, cooking and washing, Eliza will have more time for her household chores and for farming. Most important, she is hopeful that safe water will put an end to her seven-year-old son's chronic diarrhoea.

Source: WHO. 2001. *Water for health: taking charge*. Geneva.

Guinea: boreholes make a lasting difference

Twenty years ago, an estimated 30 percent of rural people in Guinea were obliged to walk more than 2 km to reach a water source. In many villages, the under five-year-old death rate from water-borne disease, including diarrhoea, was unacceptably high.

In 1985, the Islamic Development Bank (IDB) was asked to fund the provision of water points in three of the country's poorest districts. With an IDB loan of US\$6.4 million, the Service national d'aménagement des points d'eau (SNAPE), in collaboration with two German consulting firms, sank boreholes and installed pumps in 350 villages.

Nine years later, an IDB team returned to Guinea to evaluate the project and found that the project had produced substantial social and economic benefits. Women were quickly and easily able to collect and use clean, fresh water all year round, devoting the time they saved to other work. Thanks to a public awareness campaign run by SNAPE, the burden of diarrhoeal diseases among small children had been significantly reduced. An effective policy of pump maintenance and replacement, supported through village water committees, meant that virtually all the pumps were still working.



Source: K. Allaoui, IDB, personal communication.

treating children suffering from diarrhoea and can be made readily available in the community at a low cost. However, although ORT saves lives, it does not prevent children from being reinfected.

Safe, fresh water can be provided in the following two major ways:

- An easy, low-cost intervention is to improve the facilities for collecting and storing rainwater. For example, the water that falls on tin roofs can be collected in pipes and diverted, either to a clean container or to a larger water tank. Containers should be covered to prevent children from putting their hands in the water. Domestic animals should also be kept away, and always watered separately from humans.
- More expensive is the provision of water at the community level through the construction of boreholes or wells, which usually requires the intervention of the government, donor agencies or NGOs. Boreholes and wells must be equipped with suitable pumps that can be maintained locally, and wells must be protected from surface runoff, which is a source of contamination.

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India: fundamental and sustainable improvements



WaterAid, an NGO based in the United Kingdom, is dedicated to the provision of safe water and sanitation to the world's poorest people. The WaterAid India Office works with 70 indigenous NGOs on projects in five Indian States (Tamil Nadu, Andhra Pradesh, Karnataka, Maharashtra and Orissa), installing borewells and handpumps and promoting good hygiene practices in poor communities.

When a participatory assessment was conducted in 1999 to evaluate the long-term impact of WaterAid-supported projects carried out between 1991 and 1993, it was found that fundamental and sustainable improvements had been achieved in people's health and livelihoods. Among the most important improvements were the reduction of diarrhoeal episodes and increased school attendance among children, together with decreased time and labour required by women for fetching water.

Source: WaterAid. 2001. *Looking back: the long-term impacts of water and sanitation projects*. London.

Both options depend on the existence of a plentiful supply of clean, fresh groundwater, which must not be overdrawn if the supply is to be maintained.

The building and proper use of clean family latrines is an important measure that can reduce the risk of diarrhoea. Latrines should be sited at least 15 m away from people's living area and downhill from any water supply, such as a spring, stream, pond or well. Entrances and openings should be covered tightly to prevent the latrine from becoming a breeding place for flies and other disease vectors.

In addition to the provision of clean water and latrines, the main factor in reducing diarrhoea lies in behavioural change. The simple act of washing hands with soap and water before meals and after using latrines can reduce infections by one-third. Other good hygiene practices that need to be more widely promoted include the boiling and/or chlorination of water used for cooking or washing, breastfeeding rather than bottle feeding, and the appropriately timed introduction of safe and nutritious complementary foods. Experience has shown that all these practices can be encouraged through public education campaigns, but that such campaigns must be periodically repeated if their impact is not to fade over time.

Investment in improved water systems

Much has been learned from experiences in the provision of water supplies at the community level. Following are some key principles for ensuring that rural water programmes are effective and sustainable:

- Programme implementation must be participatory. Involvement of the entire community is essential for ensuring that institutions such as village water committees receive broad support, and hence for the

sustainability of any programme. Experience shows that people are prepared to observe the simple rules and practices concerning proper use of the village water point, provided they have been actively involved first in formulating, and subsequently in assessing the effectiveness of interventions.

- Village water committees, launched and sustained through public awareness campaigns, can be effective instruments for ensuring that pumps are maintained, repaired and eventually replaced. The costs can be met through a committee-administered fund, to which all water users contribute. Villagers must realize the importance of keeping up their contributions to this fund, against the day when the pump may have to be replaced.
- Local repairers need to be trained and equipped to service pumps regularly. A national network of spare part suppliers is essential for ensuring easy access to parts as soon as these are needed. Both these conditions are more easily met when standard pump models from manufacturers with a strong national presence are installed. The use of standard models also encourages the sharing of knowledge and experience among neighbouring villages.

In conclusion, implementing integrated programmes that combine the provision of safe water with the introduction of adequate sanitation facilities and hygiene practices can bring about a sustained reduction in the morbidity and mortality caused by diarrhoeal diseases. Their widespread adoption could make a sizeable contribution to reducing the number of undernourished people in developing countries.



Seeds of success

Increasing seed security is crucial to reducing poverty and hunger. There are many low-cost ways in which governments and the international community can support resource-poor farmers as they organize themselves to multiply and disseminate the seeds of new and traditional crop varieties.

Improving farmers' access to good-quality seed of productive, well-adapted crop varieties is one of the key means by which the development community can help to improve the food security and well-being of poor rural people.

The genetic quality or inheritance of a variety sets the upper limits on the yield that can be achieved. It is also the main determining factor in how a plant responds to fertilizers and other inputs intended to increase productivity as well as to stresses such as drought, poor soils and pest attacks. The physical and physiological quality of seed determines its viability and strongly influences the successful establishment of the crop.

Seed insecurity is strongly correlated with rural poverty and food insecurity. Yet

Bean seeds provided by international donors



FAO/17657/6-DIANA

few developing countries have adequately addressed the need to improve their national seed supply systems. The seed of most food crops grown by resource-poor farmers is not produced by private companies or the public seed sector; instead, farmers themselves save a quantity of seed from each harvest to sow their next crop. Under normal conditions,

this provides an element of household food security. However, when unfavourable growing conditions result in poor yields, food stocks are squeezed and it is difficult for hungry households not to eat their seed stock. The result may be a chronic shortage of seed throughout the farming community. And when natural or human-induced disaster strikes, seed

Advantages of quality seeds

- **Better genetic quality.** The genetic composition of the seed is fundamental to the success of the crop, determining both yield potential (the maximum yield under optimal growing conditions) and the crop's tolerance to stresses such as drought, waterlogging, frost, low soil fertility and attacks by diseases and pests.
- **Better germination.** If farmers know that their saved seeds are not of good quality and expect only a proportion of the stock to germinate, they will plant a greater quantity than normal to compensate – for example 80 kg of doubtful seed instead of only 50 kg of good quality seed. The 30 kg difference could either have been eaten or sold for income.
- **Reduced labour.** Farmers expecting poor germination may also put several seeds in a pocket, so they can subsequently transplant seedlings from pockets in which more than one emerged. If seed is of good quality, they do not have to perform this labour-intensive activity and can devote more labour to other urgent tasks, such as weeding. A lack of labour for weeding is one of the main factors keeping crop yields low in resource-poor farming systems.
- **More vigorous seedlings.** Good seed germinates at the right time and produces seedlings that are strong enough to withstand adverse conditions when they emerge. Young stems are able to break the soil, the young root systems are strong enough to support the plants, and the first leaves do not wither in the sun or heat.
- **Fewer disease problems.** A number of crop diseases can be carried inside or on seed and may negatively affect germination or vigour and damage the growing crop. Good-quality seed should be disease-free. Strong seedlings are also more likely to resist infection by diseases already present in the soil.

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stocks may run out altogether, as they are either destroyed or else have to be eaten to stave off hunger.

Public and private sectors

New varieties of the food crops grown by poor farmers are usually developed by plant breeders in the public sector, but the governments of many developing countries lack the resources to multiply

and distribute adequate quantities of seed. The private sector, on the other hand, is unwilling to invest in supplying a market that offers low profit margins, especially with seeds that farmers can subsequently multiply and store for themselves.

Under the right circumstances, seed shortages can provide an opportunity to introduce new varieties and crops and to

Afghanistan: food for seed



In Afghanistan, FAO and WFP have collaborated in a successful food-for-seed programme. Improved seed varieties are multiplied by contract farmers and exchanged by the programme for WFP food wheat, at a ratio of 1:1.25. The seed procured is then cleaned, treated with fungicide to protect it against soil-borne disease, and bagged before being redistributed to contract farmers for further multiplication. Fertilizer is also supplied to contract farmers.

The programme is assisted by NGOs and implemented through local farming communities. Procuring seed directly from farmers contributes to the strengthening of local skills as well as increasing seed production and the adoption of new varieties.

Yakawlang district of Bamyan province, where the programme has been particularly active, is a remote, high-altitude region of central Afghanistan, prone to frequent fighting. In 1997, in response to an impending famine, 1.4 tonnes of seed, together with fertilizer supplies, were delivered to the district. Twenty-eight farmers were contracted and the seed was sown. In the autumn of 2000, some 550 tonnes of seed (mostly derived from the initial sowing) was procured and redistributed to farmers, not only in Yakawlang but also in five adjoining districts in two adjacent provinces, Ghor and Uruzgan.

Source: FAO. 2000. *Annual Report: Seed Component. Food security through sustainable crop production (AFG/96/004)*. By N.S. Tunwar.

Colombia: integrated research and development at the village level

Farmers in southern Colombia's Cauca province are benefiting from a new kind of village institution: the Comité de Investigación Agrícola Local (CIAL), the local agricultural research committee.

The CIAL concept arose from local farmers' wishes to conduct their own research to evaluate innovations. It was initially developed and tested by the International Centre for Tropical Agriculture (CIAT), but the CIAL model has since been adopted by research institutes, NGOs and universities in several Andean and Central American countries. A CIAL has four or more members elected by the local community – a president, secretary, treasurer and extension officer – all of whom act as researchers on topics agreed democratically by the local community. The research is funded by a small grant, which is usually donated by the external agency facilitating the CIAL process.

In their early stages, most CIALs conduct research to improve the yields of staple food crops, such as maize and beans. Seeds of improved varieties, usually obtained through the supporting agency, are thus an important input into the research process. The CIALs test new varieties and make recommendations to the local community on which varieties represent an improvement over traditional landraces.

Although their primary purpose is to conduct research, many CIALs develop into successful small-scale seed enterprises, each serving the area surrounding its home village. Seeds are sold at a high enough price to recapitalize the village research fund, if not to make a profit. Farmers are able to buy seed in the confidence that it is of good quality and of a variety suited to their needs. Besides acting as a channel for the dissemination of improved varieties, CIALs often serve as a focal point for other activities of benefit to the local community, such as applying for additional allocations of land or restocking the village shop with input supplies.



Source: A. Ashby, A. Braun, T. Gracia, M. del Pilar Guerrero, L. Hernández, C. Quirós and J. Roa. 2000. *Investing in farmers as researchers: experiences with local agricultural research committees in Latin America*. Cali, Colombia, CIAT.



build a better seed supply system. Where subsistence-based production still predominates, open-pollinated varieties maintain farmers' freedom to save their own seed and will therefore continue to be popular. This will apply to most grain crops and to large areas of the countryside in several regions. However, in areas with good access to urban markets, even small-scale farmers may see a shift to modern hybrids as an attractive option because of their high yield potential. In this case, private sector companies are the main seed suppliers.

Wheat and maize are the two main food crops in which the private sector

currently plays an important role.

However, food crops such as groundnut and pearl millet, which have export or other commercial potential, offer scope for greater private sector involvement in the future. In a few countries, including India, a strong private seed supply sector has already developed for certain staple crops, such as pearl millet.

Meeting emergency needs

When emergencies occur, the existence of a system for multiplying and distributing quality seeds is essential for restoring food security. In such situations, international humanitarian agencies,

research centres and stations, extension services and local farmers' groups commonly work in partnership. Much has been learned in recent years about the need to target introductions accurately under emergency conditions, despite the need for speed. Appropriate crop varieties that are likely to be adapted to local agro-ecological conditions need to be identified, either in the specific country or in other countries with similar growing conditions. Once found, they must be evaluated by researchers, farmers and consumers to make sure that they really are adaptable to local growing conditions and are acceptable to local tastes. Finally,

Somalia: building on a traditional market



A recent study of the seed sector in southern Somalia found that relief seed distributions immediately following the conflict in 1992 were much appreciated, but that farmers have since been able to access seed through the informal seed system. This system consists of a network of small-scale traders, predominantly

women, who buy fresh seed from farmers after harvest, store it separately from grain to ensure that it retains its viability, then sell it back to farmers for cash at the start of the next season.

In 1998, the Cooperative for Assistance and Relief Everywhere (CARE) initiated a community-based project to produce sorghum seed with farmers who had access to irrigation along the lower Shabelle River for supply to farmers in rainfed areas. The International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) supplied foundation seed of six improved sorghum varieties, which was then multiplied by farmers with the support of local NGOs working with CARE. Three varieties performed exceptionally well, and a total of 400 tonnes of "certified" seed was produced.

The next challenge was how to market this seed. Similar schemes have relied on humanitarian agencies to purchase seed for free distribution to farmers, but if farmers were able to access seed through the informal system, there would be little reason to continue with free distribution. It was decided to find out if women traders would be interested in the activity. Their response was enthusiastic; they were

sold small (1 kg) seed packs by the project on the understanding that they could return any not sold after three months, provided the packs had not been opened. Within two weeks, the traders operating at Baidoa, a major market town in southern Somalia, had sold 4 800 packs. Many more were sold through markets in other towns and villages.

This experience teaches several important lessons. First, the project organized the sale of small seed packs in this way as an experiment to test the market for seed of new varieties. It showed that farmers are willing to purchase small amounts of seed of new or unfamiliar varieties and that the informal system can be an excellent mechanism for disseminating such good-quality seed rapidly. Second, the experience has also shown the importance of research on seed systems. The understanding, derived from research, of how farmers traditionally access seed allowed an intervention to be designed that would strengthen the traditional system rather than undermine it. Third, humanitarian agencies and other organizations working in the seed sector need to respond quickly and flexibly to changing conditions. Just as seed needs to be supplied in bulk rapidly as soon as an emergency occurs, so also should such distributions promptly cease once the emergency is over. Continuing large-scale free distributions can threaten the livelihoods of small-scale seed traders.

Source: C. Longley, R. Jones, M.H. Ahmed and P. Audi. 2001. *Seed sector study of southern Somalia*. Report to EC Somalia Unit, Nairobi.

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extension and NGO field staff need to be trained to bring appropriate agronomic practices as well as improved storage and processing methods to the attention of the farm households concerned.

Helping communities help themselves

Once an emergency situation has passed, or wherever the formal private sector remains weak, the best way of encouraging quality seed production and dissemination is to support the development of small-scale community-level seed enterprises. These may take a variety of forms, consisting of women's groups, church groups, farmers' associations, schools or even village-level research committees. As yet, such enterprises meet the needs of only a tiny proportion of farmers, but anecdotal evidence suggests that they are becoming increasingly active, filling the vacuum left by the formal public and private sectors. Significantly, many private concerns are reaching out to the public sector for support in the form of foundation seed of new varieties and training in seed production. There is potential therefore for these enterprises to become an important catalyst for the widespread adoption of improved varieties.

Community-based seed production enterprises are the building blocks of an emerging bottom-up private seed sector in many developing countries. An enabling policy and institutional environment is essential to ensure that they continue to establish and flourish. Access to credit, microfinance, a high-quality yet user-friendly national seed service and the encouragement of outreach activities in public sector research organizations are some of the policy instruments that should ensure success. It is particularly important to motivate plant breeders and other researchers to disseminate new technology rather than merely develop it.

Zambia: community-based organizations ensure speedy adoption of new varieties

In Zambia, the main agricultural activity of CARE's Livingstone Food Security Project has been the introduction of drought-tolerant crops through a community-based seed bulking and distribution scheme. The crops covered initially were maize, sorghum and cowpea. Related agronomic information, seed handling and post-harvest storage were included in the extension messages shared with farmers.

In the pilot season of 1994/95, some 330 farmers participated, almost entirely on an individual basis. The seed groups in each village were federated to form a Village Management Committee (VMC). For the 1995/96 season, 180 VMCs representing 1 208 seed groups or about 6 800 participating farmers were established. Each season, more groups were added as more households joined the scheme. Eventually, it became necessary for the VMCs to federate in their turn to form Area Management Committees, which serve the interests of several adjacent villages. A further expansion of the scheme increased the number of participating farmers to 9 600 in 1996/97 and to more than 12 000 in 1997/98.

Repayment terms were agreed on in advance of seed distribution. Each farmer received enough seed to sow about 0.25 ha (either 5 kg of maize, 4 kg of sorghum or 3 kg of cowpea). The rate of repayment was a sufficient quantity of seed for each remaining member in the group to plant an equivalent area the following season, in addition to one portion of seed entrusted to CARE for allocation to a farmer in a new group. Depending on the group's size, this could add up to about four times the loaned amount. The scheme's rapid expansion has been aided by two factors: the high priority that farmers attach to drought-tolerant crop varieties and the strategy of using community-based organizations.

Source: FAO. 1999. *FARMESA: A case study on community-based seed supply systems* (GCP/RAF/334/SWE). By G. Mitti.



The strength of informal seed systems often depends on key individuals in the community who are known for their seed management skills. The first step is to identify these individuals as a basis for understanding the local system and subsequently strengthening their activities and spreading their skills.

There are many models of successful seed multiplication and dissemination to choose from and no single model is universally applicable. However, at both the national and international levels,

increased resources are needed to make sure that good seeds – which are the very foundation of food security – reach all the world's resource-poor farmers, and not just a tiny minority as at present.



Propagating prosperity

Improved methods for cultivating starchy staple crops should help to restore food security and improve rural livelihoods. A combination of new technology and new forms of farmers' cooperation is revolutionizing the way these crops are propagated and disseminated in some of the world's poorest farming communities.

Ghana was one of the countries highlighted in *The State of Food Insecurity in the World 2000* as having made remarkable progress in reducing undernourishment. When per capita food intake rose from 1 790 to more than 2 600 kcal per day, much of this success was attributed to farmers' adoption of high-yielding cassava varieties. Developments elsewhere in Africa include the use of tissue culture to provide clean banana planting material in Kenya, and the adoption of disease-free "seed" potato tubers, which have more than doubled average yields in Uganda. Cassava cultivation is also helping the Democratic Republic of the Congo to restore food supplies after years of war and economic disruption.

These different success stories have one thing in common: they concern crops that are vegetatively propagated. Cassava is traditionally propagated with stem cuttings, and bananas from suckers cut from around the base of the parent plant. When people talk of "seed" potatoes, they refer to small tubers used to start the new crop.

Vegetative planting material confers some advantages. Each plant is genetically identical to the parent plant and to its siblings, so the traits of good varieties are easily maintained by farmers and the new crop stand tends to be relatively uniform. Furthermore, the relatively substantial food reserves carried by the planting material can help to establish the crop in the face of drought, pest attacks or other adverse conditions. Indeed, the rugged, undemanding nature of several

vegetatively propagated crops has made them vital food reserves in areas with poor soils and in times of environmental stress or civil strife. On the other hand, under good growing conditions, crops such as banana, plantain, potato, sweet potato and cassava can produce impressive quantities of energy-rich food: fresh weight yields of 20 to 40 tonnes per hectare are readily attainable.

The downside is that pests and diseases are also readily propagated – from one season's crop to the next, or from one field to the next – along with the planting material. Viral diseases in particular are carried in the tissue of the planting material and their transmission may not even be recognized by farmers as an avoidable problem. Moreover, genetically identical stands of a crop are all equally susceptible to any new disease strains that may appear. And when planting material needs to be replaced in a hurry – for instance, after a pest epidemic or when war or famine has resulted in its widespread loss – propagation can be painfully slow. Vegetative planting material is also bulky and expensive to transport.

Fortunately, with new technologies and action enabling farmers to help themselves, these obstacles are being overcome. As a result, crops such as banana, potato and cassava are starting to play an increasingly important role in reducing food insecurity.

Tissue culture raises banana yields and incomes in Kenya

In the highlands of Kenya, almost every farm household has a small banana orchard. Bananas are important both for food and for cash, providing the women who grow and market them with a small but much needed source of income to pay for household necessities. Because of the decline of coffee, the traditional cash crop, many families are becoming more dependent on bananas for their livelihood. At the same time, however,



FAO/18425/P/CEN/INI

Banana bunches in a market stall

banana yields are declining, mainly because of the buildup of pests and diseases. Weevils, nematodes and viruses are all transferred from infested orchards with the basal shoots or "suckers" used to establish new plants.

These problems are being addressed through a dynamic partnership that brings together the country's public sector biotechnology researchers, its nascent private sector biotechnology industry and innovative farmers. The partnership began in 1997, when the Kenya Agricultural Research Institute (facilitated by the International Service for the Acquisition of Agribiotechnology Applications) launched a project on bananas.

The project's central technical ingredient is tissue culture or micropropagation, a set of techniques used to multiply pest- and disease-free planting materials. Small pieces cut from

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A project beneficiary

Esther Gachugu was one of the demonstration farmers and an early adopter of the tissue culture technology. Her family's modest banana plot has been transformed into a profitable enterprise, yielding the equivalent of up to US\$300 from a single day's sale of fruit in Nairobi. Esther has become a convincing advocate of the new technology, training other farmers in all aspects of its use. Among her investments is a new kitchen which allows her to feed her family in comfort.

Source: F. Wambugu. 2001. *Modifying Africa: How biotechnology can benefit the poor and hungry, a case study from Kenya*. Nairobi.



Esther Gachugu
and her son

a clean shoot-tip of a desirable variety are grown in a sterile artificial medium in the laboratory to produce numerous tiny plantlets. These are carefully hardened off in greenhouses to produce plants that can be grown outdoors. If established in pest- and disease-free soil and carefully nurtured through their critical period of establishment, tissue-cultured banana plants are much more productive than conventionally propagated varieties. Starting afresh with tissue-cultured planting materials also provides an opportunity to introduce new, high-yielding varieties with resistance to destructive fungal diseases such as fusarium wilt and black sigatoka.

The project's first step was to learn from experience in South Africa, where public sector research had laid the foundations for what is today a thriving private sector business, the export of mass-produced tissue-cultured plantlets. South Africa's Institute of Tropical and Subtropical Crops generously provided its expertise in propagation techniques to Kenyan institutions, while a private South African company, DuRoi Laboratories, supplied the first planting materials for field evaluation in Kenya. South Africa's model of public-private partnership was replicated in Kenya by involving a private Kenyan company, Genetic Technologies Ltd (GTL), to ensure the mass production of plantlets, using the techniques developed through public research.

Next, tissue-cultured plantlets were tested for their acceptability in the farming community, using a group of 150 "demonstration" farmers in Kenya's four main banana-producing areas. These farmers received their initial supply of tissue-cultured plantlets free of charge and were formally trained in how to manage them. The high yields they achieved elicited great interest in the wider community, prompting the project

to aim for mass production and dissemination. At this point there was a setback, however, since few farmers were able to afford the investment of US\$200 needed to buy enough plants to benefit in terms of output and income.

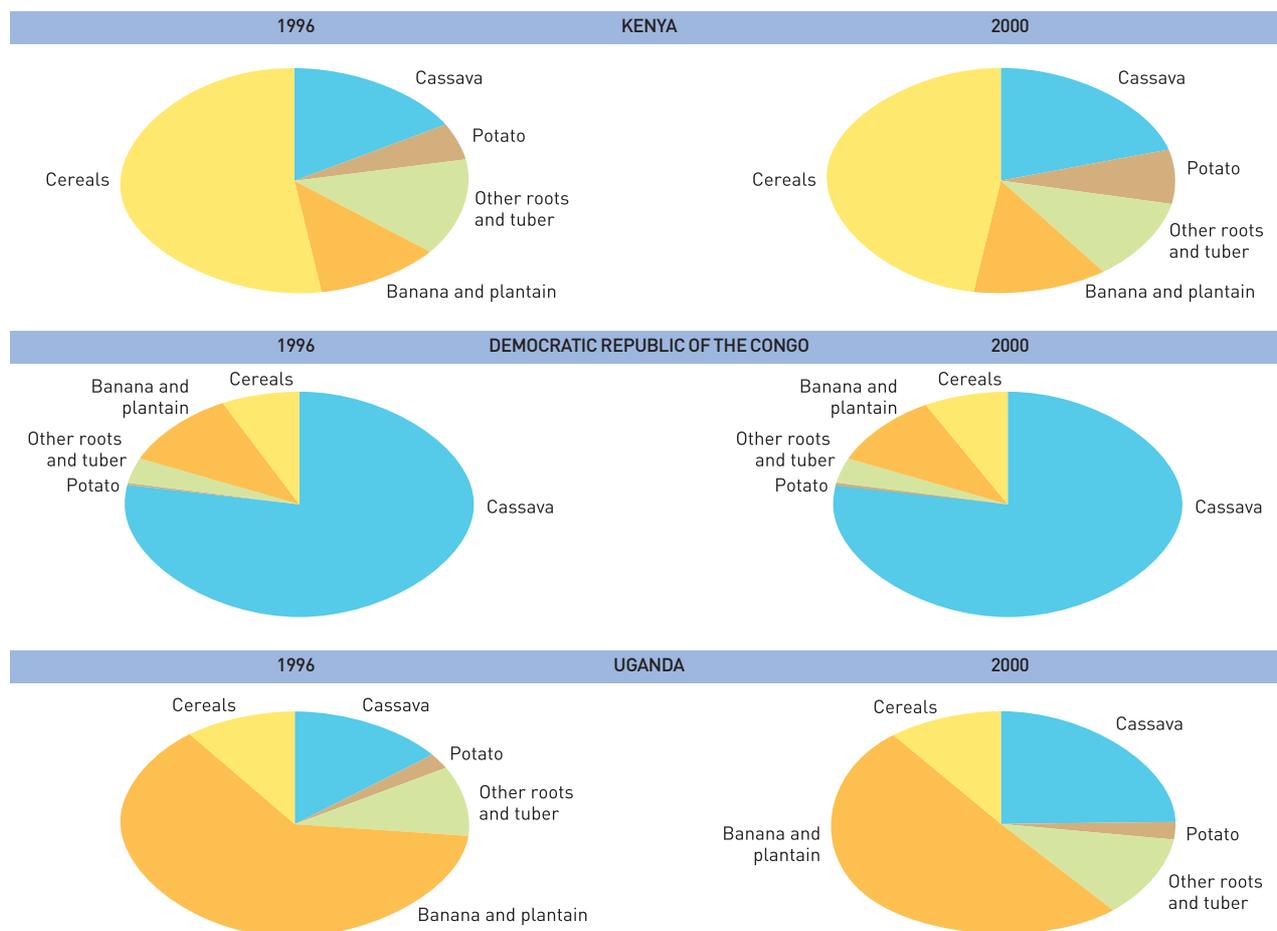
This problem has now been overcome by forming microcredit groups. Based on the successful Grameen Bank model developed in Bangladesh, groups of about 20 to 40 farmers are able to pool their resources to acquire truckloads of plantlets from GTL. Group members are jointly accountable for loans taken from a revolving fund, and they work together and share management information.

For farmers who have made a success of the new technology, the payoff has been considerable. The heavier and more predictable fruiting of the tissue-cultured bananas has made the fruit easier to market commercially, while the formation of farmers' groups, initially to obtain credit, has empowered the growers in their marketing efforts. Farmers are able to sell in bulk, directly into urban markets such as Nairobi, instead of in small quantities to intermediaries. Investments in irrigation technology and improved soil fertility, initially undertaken to help establish the banana plantlets, have improved the productivity of entire farms. The new varieties have proved popular with consumers, and their resistance to pests and diseases assures their popularity with growers.

The demand for tissue-cultured plantlets of banana and other crops has provided new jobs in the growing biotechnology sector, while the increased production of bananas should in due course stimulate the development of processing industries. If this is achieved, an innovation in planting material technology will have catalysed the transformation of a neglected subsistence crop into a new source of prosperity.



Figure 17. Contribution of the major vegetatively propagated crops to total crop production



Communities take better care of their seed potatoes in Uganda

Farmers in Kabale district, in the cool highlands of southwestern Uganda, supply food for some of the densest rural populations in the world – about 370 people per km². Growing potatoes is a relatively recent innovation here, but the crop has rapidly become a vital source of both food and cash. Unfortunately, there is no formal system for maintaining seed quality and, in the absence of a strong body of local traditional knowledge,

farmers have developed their own ad hoc practice. This simply consists in selling the largest tubers for cash, eating the medium-sized ones and keeping the smallest tubers as planting material for the next crop. The outcome has been the buildup of diseases, especially viruses such as potato leaf roll virus. Yields have become erratic and have declined overall.

In 1995, with support from the national and international research community, a group of about ten farmers formed the

Uganda National Seed Potato Producers' Association, an initiative which was to prove critical in solving the problems stemming from current practices. The Association has since grown to 19 members – 7 women and 12 men – and has so far provided some 267 tonnes of improved seed potatoes to 3 570 households, benefiting almost 33 000 people in 73 communities.

Disease-free local potato varieties and new varieties from the International Potato Center in Peru are multiplied at

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*Placing cassava
on a communal drier*

research stations of Uganda's National Agricultural Research Organization. The Association then organizes the remultiplication of clean seed at the community level. Training in integrated production and pest management techniques, which can help to keep the new crops disease-free, is a vital complementary component of the programme. This is provided by the regional technical support network, the Programme régional d'amélioration de la pomme de terre et de la patate douce en Afrique Centrale et de l'Est (PRAPACE). Meanwhile, an effort to improve storage practices helps to take better care of the extra seed potatoes produced. Over 60 diffused light stores, each with a capacity of 5 tonnes, have been installed, reducing seed potato losses from 40 to 26 percent.

The combined effect of using better planting materials, introducing new varieties and adopting improved production techniques has allowed farmers in Kabale district to more than double their yields – and, what is more, has restored their confidence in the potato as a staple food and as a source of household income.

Cassava will help the Democratic Republic of the Congo back on its feet

Through years of civil war and the disruption of trade and agriculture, the tough cassava plant has been one of the staple crops that have fed the people of the Democratic Republic of the Congo. No crop really "thrives on neglect", but cassava comes the closest to it, almost always managing to produce a yield despite drought, poor soils, pests and diseases and virtually a total lack of inputs and management. However, no



FAO/9318/R, FAO/IT

new cassava materials have been introduced in this country for several years, so pests and diseases have spread unchecked. Most dangerously, a particularly destructive form of cassava mosaic disease is spreading from the Great Lakes region of Central Africa, reducing cassava yields almost to zero at the advancing front of the epidemic.

Tissue culture has played a vital role in tackling the problem, but in a different way to the banana case discussed above. In the Democratic Republic of the Congo, it provided the cheapest and most effective means of transporting clean planting materials to the country from the Nigeria-based International Institute of Tropical Agriculture. Some 200 elite cassava clones have now been flown into the country for evaluation by farmers. However, the major challenge still lies ahead: to multiply and distribute enough resistant cassava material to counteract the mosaic virus epidemic. A project has been established by FAO and the Government of the Democratic Republic of the Congo, under which 1 million metres of stem cuttings per year of four resistant and locally adapted varieties will be multiplied and disseminated.

The first round of multiplication has already begun at three locations, using rapid propagation techniques which, although less sophisticated than tissue culture, offer major advances over traditional procedures for taking cuttings, both in terms of increasing the rate of propagation achieved and ensuring disease-free planting material. Some 300 000 m of stem cuttings should be ready for distribution by October 2001. A further eight locations will then be brought into the multiplication effort. The farmers' groups and extension agents who will be involved at these locations are already being trained. At the third stage, farmers' associations and community groups will take over responsibility for multiplication and distribution, while field schools will play a vital role in building farmers' knowledge of the integrated production and crop protection techniques that will help to maintain productivity in the longer term. Such investment in human capital is vital if improved planting materials are to make their full contribution to averting food insecurity and improving livelihoods.



Improving fish safety and quality in Africa

Conventional wisdom holds that domestic food security declines when fish exports rise. This can happen in inland waters, where the fishing area is limited, but it need not be the case in offshore fisheries, as African experiences show.

World trade in fish and fishery products has grown rapidly over the past 20 years, rising in value from US\$8 000 million in 1976 to US\$52 900 million in 1999. Fish exports have become a major source of foreign exchange earnings for developing countries, which now account for roughly 50 percent of the international fish trade.

To sustain or expand their share in fish exports, many developing countries have placed fish safety and quality at the centre of their trade development and promotion policies. The international development community has been assisting in the establishment of the control systems needed to meet the food safety and quality regulations imposed by importing countries.

How does improving the safety and quality of fish products for export contribute to domestic food security? It is sometimes argued that promoting fisheries exports from developing countries could have the opposite effect, endangering the nutritional status of poor people because of the possibility of a decline in domestic supplies.

On the contrary, domestic food security can benefit from export trade in various ways. First, at the macroeconomic level, the earnings from exports of high-value fishery products, such as lobsters or shrimps, may be reinvested in large quantities of less expensive food, which then becomes available to nutritionally vulnerable people. At the microeconomic or household level, an increase in fish exports creates jobs and raises incomes for poor people, who then have more to spend on food. This is especially the case in fisheries sectors where a large



Transporting a tuna fish

FAO/17114/M/MARZOT

proportion of the fleet is artisanal, i.e. managed by individual fishermen who operate on a small scale. Furthermore, improvements in the food safety and quality of fish exports spill over to domestic supplies because the same

facilities, equipment and people are employed in both sectors. In addition, because interventions to enhance food safety and quality serve to prevent post-harvest losses and may allow a larger area to be fished, the quantity of fish products available to consumers may also rise, resulting in downward pressure on prices.

Africa's experiences

Africa provides positive case studies of these mechanisms at work. During the 1990s, Africa's fish exports rose by 10.2 percent per year – far faster than its fish imports, which grew by only 2.3 percent. Consisting mainly of higher-value fish, exports are now worth about US\$2.1 billion annually, more than twice as much as imports (US\$1 billion).

Several countries have used the

What is the HACCP system?

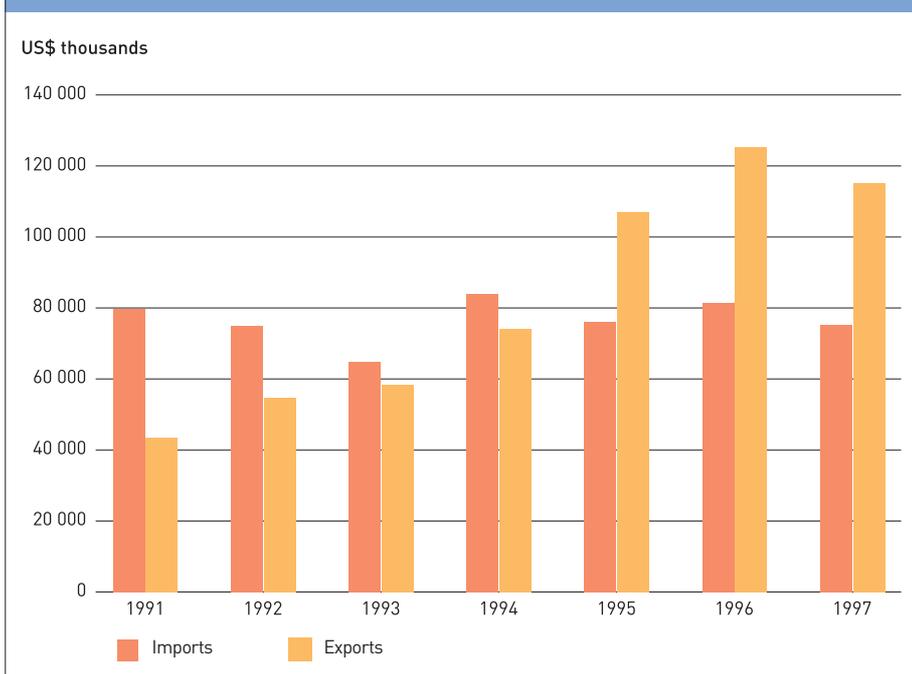
The Hazard Analysis Critical Control Point (HACCP) system was originally developed in the 1970s to ensure food safety for astronauts participating in the United States' space programme. It has since become the world's preferred system for assessing and improving food safety. Following are the seven HACCP principles:

- Conduct a hazard analysis
- Determine the critical points at which control measures are needed
- Establish the critical limits that determine acceptable or unacceptable standards
- Establish a system to monitor critical control points
- Establish corrective action to be taken when monitoring indicates that a critical point is not under control
- Establish procedures to verify that the system is working effectively
- Document procedures and keep records appropriately.

Guidelines for applying HACCP systems have been adopted by the Codex Alimentarius Commission, the body responsible for implementing the Joint FAO/WHO Food Standards Programme. The guidelines are widely used as a basis for training programmes.

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Figure 18. Total value of fish exports and imports in sub-Saharan Africa, 1991-97



revenues generated by these exports to import less expensive foods. Egypt and Nigeria import low-value fish species such as herring, sardine and mackerel. Exporting countries with a small domestic market for fish import other foods, such as poultry and dairy products. In Mauritania, for example, which has little arable land, such imports are vital for food security.

With assistance from FAO and other development agencies, many African countries have introduced fish inspection and quality assurance (FIQA) programmes, which are now mandatory for all countries exporting to the European Union (EU) and other parts of the developed world. These programmes are preventative (designed to avoid losses throughout the food chain) in contrast to the end-product testing systems used by importing countries. The industry takes responsibility for implementing the programme, while government

inspection agencies monitor activities and regulate exports accordingly. The major tool used in FIQA programmes is the Hazard Analysis Critical Control Point (HACCP) system.

Originally applied by countries in the North, HACCP systems used in fisheries need to be adapted to the different conditions found in Africa and other developing regions. For example, bacterial spoilage patterns of tropical fish are different from those of cold or temperate water fish, requiring specific control measures. Likewise, many fish-processing operations are performed manually in developing countries, so more emphasis needs to be placed on personal hygiene, whereas in the developed world operations are largely mechanical, requiring more emphasis on the sanitation of equipment.

In the 1980s, FAO worked with national and other partners to provide training in the development and application of

appropriately adapted HACCP systems in African countries. Morocco was the first country to benefit, and the model developed there has been diffused in other countries.

A major technical innovation in improving the safety and quality of fish products in sub-Saharan African countries was the development of a system for chilling fish on board small boats. In the early 1980s, insulated containers for ice were designed to fit the narrow dugout canoes or pirogues used by small-scale fishermen, while small plants for manufacturing ice were developed onshore. These technologies not only prevented spoilage but greatly increased the area that could be fished, since boats were able to remain at sea for five to six days, instead of the 24 hours or less that had been possible previously. As a result, catches by small-scale fishermen have increased dramatically and losses have been greatly reduced.

African countries have seen their investments in fish safety and quality pay handsome dividends. To export fish for human consumption to the EU, they must be entered on its List I, including countries deemed to have an effective FIQA programme in place. Of the 54 countries currently on this list, 13 (nearly one-quarter) are African. Among them are Senegal and Mauritania, whose contrasting cases show the range of situations under which food security can benefit as fish exports rise.



A tale of two sectors: Senegal and Mauritania

Fish is a traditional food in Senegal, which has a long-established fisheries sector and was also among the early adopters of a FIQA programme. Having requested international assistance in 1988, Senegal launched its new programme in 1990 and, by 1998, had increased its annual fish production by 35 percent, from 315 000 tonnes to 427 000 tonnes. Nearly one-third of the 1998 total (140 000 tonnes), was exported, earning the country about US\$299 million in hard currency. Over the same period, the domestic consumption of fish rose from 25.3 kg to 36.3 kg per capita per year. That compares with a world annual average of 16 kg per capita. About 400 000 to 600 000 people are now employed in Senegal's fisheries sector, 80 percent of which is artisanal.

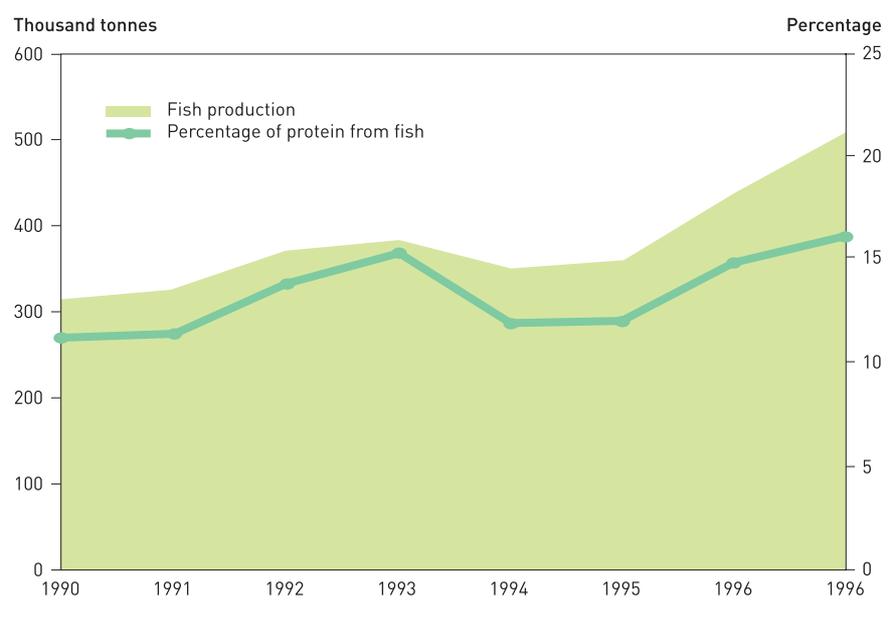
In Mauritania, fish consumption is relatively low and the fishing industry is nascent. The annual catch landed by Mauritanian fishermen has risen steadily in recent years to its current level of around 85 000 tonnes. Most of the catch is exported to Japan and the EU, generating an estimated US\$135 million in hard currency earnings. In a poor country

consisting largely of desert, fish has become the principal source of wealth and is often referred to as *l'or bleu* (blue gold).

In March 1996, the EU imposed a ban on fish imports from Mauritania for safety and quality reasons. The result was a devastating loss of earnings, estimated to be US\$16 million for the fishing industry and representing 70 percent of the government's revenues. The ban was lifted as early as July of the same year, however, after the country had initiated a FIQA programme. The rapidity with which the programme was established, together with its early success in restoring exports, owed much to high-level commitment from government and national institutions which, with the assistance of the international community, were able to draw on the experience of Morocco and Senegal to fine-tune the programme to Mauritania's needs.

In Senegal, domestic fish consumption has risen in parallel with exports while, in Mauritania, total protein intake has risen, reflecting the use of the hard currency derived from fish exports to import other forms of animal protein.

Total fish production, protein consumption and fish protein consumption in two West African countries



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Zambian boy revisited

Last year's issue of *The State of Food Insecurity in the World* reported on the diet of seven-year-old Mumba, who lives with his family in Zambia's Luapula Valley. Since then, the prospects for household food security and nutrition in the area have substantially improved thanks to an FAO project.

In January 1997, FAO and the Government of Zambia began implementing an integrated five-year project to improve household food security and nutrition in the Luapula Valley. The project is funded by the Belgian Survival Fund.

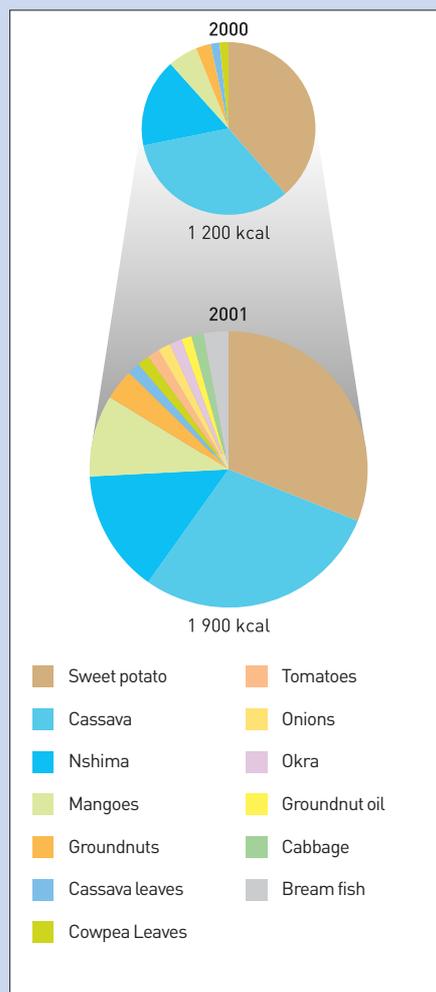
Despite efforts to develop its agriculture, infrastructure and community services, Luapula Province remains one of the poorest parts of Zambia. Many households are chronically food-insecure and a large proportion of the population is nutritionally vulnerable. This has a severe impact on children's health. In 1997, 59 percent of children under five years of age were stunted, 3 percent were wasted and 29 percent were underweight.

Micronutrient deficiency diseases, especially vitamin A deficiency and iron deficiency anaemia, are also widespread, with 50 percent of children under five having a mild to moderate deficiency of serum-retinol and 76 percent suffering from anaemia.

Malnutrition is higher in the rainy season because staple foods such as cassava and maize are in short supply at this time and there is a high incidence of malaria and diarrhoea. With heavy demands made on them by agricultural work, mothers lack the time to ensure their children receive proper care and nutrition.

The majority of poor households do not have adequate farmland or fishing equipment, have little cash income and lack access to agricultural extension and health services. Many low-income households cannot afford to send their children to school.

Diversity in Mumba's diet, 2000 and 2001



The diets described in these charts are not necessarily representative of an average or usual intake. Rather, they are estimations of foods and nutrients for a single day of the year. Project monitoring information suggests that enhanced food availability at the household and community levels is likely to have led to the improved nutritional intakes described above. A comprehensive assessment is to be carried out in Luapula towards the end of 2001.

Higher yields of key food staples

Under the project, Mumba's family has received disease-free cuttings of a cassava variety that matures in 18 months instead of the usual 36 required by local varieties. They have also received seed of a groundnut variety that produces higher yields than their traditional variety. During the last season, the production of both crops increased and the family was able to keep enough good planting material and seed for the next season. The harvest is now sufficient for home consumption throughout the year, with a small surplus available to sell in the local market. The proceeds enable Mumba's parents to buy other commodities and to pay previously unaffordable school fees and medical expenses.

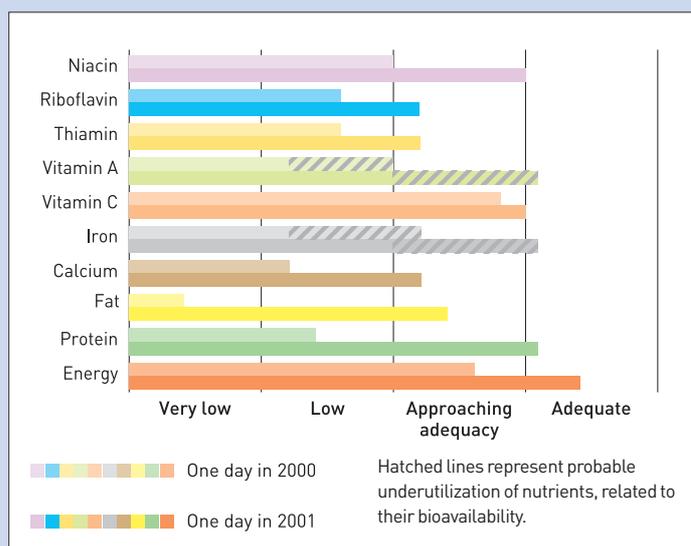
New source of vitamin A

Mumba's parents are participating in a self-help group, which has purchased higher-yielding and cold-tolerant tenera oil-palm seedlings, imported from Costa Rica and raised in central nurseries by the Ministry of Agriculture. The first fruit bunches have already started to develop on the trees planted on the edge of the wetlands, where enough water is available all year for the trees to grow well and set fruit. The women in the self-help group are keen to start processing the fruits from the new trees, as they contain nearly twice as much oil as the local variety.

The group has already learned about improved techniques for processing the palm fruits immediately after harvesting. As well as being less laborious and time-consuming, these techniques avoid fermentation, which gives the oil a strong flavour that is not liked in Luapula. At the end of the process, salt dissolved in water is added, which improves the taste and shelf-life of the oil. Before storing, the oil is dried, since any moisture left will considerably reduce its shelf-life. If it is stored in clean containers and kept in a



Two days of Mumba's diet compared



Mumba's wet season diet has improved considerably since last year. His energy intake is adequate for his age, size and level of activity. Both his protein and carbohydrate intakes are in the adequate range. Thanks to the higher-yielding groundnuts and more food purchases enabled by the family's increased income, Mumba's fat intake has improved greatly. Nevertheless, it still falls short of his needs, a situation that should be remedied when the oil-palms begin producing. His intakes of vitamin A, vitamin C and iron are better because of the increased amount of fish, meat, fresh fruits and vegetables in his diet. Nevertheless, Mumba's vitamin A utilization continues to be compromised by his low fat intake, while his iron bioavailability is low because of the high proportions of mineral-binding components in his diet. Other likely nutrient deficiencies include calcium, thiamin and riboflavin. This indicates that the high proportion of starchy staples in his diet should be substituted with other varieties of foods.

cool, dark place, the oil – which is deep red in colour and an excellent source of pro-vitamin A – keeps longer and has a better odour and taste than oils produced using traditional processing methods.

A year-round vegetable supply

Mumba's father and other farmers have started a dry season vegetable garden on a plot close to the wetland. They work as a group and have been trained to use a treadle pump to irrigate the garden with

water from shallow wells or directly from a nearby lake. They now grow a variety of local vegetables that were previously only available during the rainy season, including amaranthus, pumpkin leaves, okra and African eggplant, as well as exotic vegetables such as rape, cabbage, tomatoes and onions. Fresh vegetables are now available throughout the year and, apart from enriching the family diet with valuable micronutrients, they also provide a good source of income.

Better storage and preservation

Through practical demonstrations and discussions with the agricultural extension worker, the family has also learned how to improve the storage of their harvest. The self-help group to which Mumba's mother belongs has built an improved storage bin. Stored seeds of maize, groundnuts and beans are now better protected from rodents, insects, moulds and other pests. The family no longer needs to sell all its produce immediately after harvest (when prices are lowest) for fear of losses, and are able to keep enough food to meet its needs during the "hungry season". Mumba's mother has also learned about improved methods of drying vegetables and fruits, such as mangoes, which are plentiful during the rainy season and would otherwise perish. A simple solar dryer, built with locally available materials, helps the fruit to dry faster and, therefore, to retain more pro-vitamin A.

Getting the best from food through nutrition education

Mumba's mother and father have participated in cooking demonstrations and nutrition education sessions organized by agricultural extension and community health workers. They have learned how important it is for the boy's health and for his physical and mental development to consume a wide variety of foods from both cultivated crops and plants gathered in the wild. They have also learned about the importance of including fish and meat in the family's meals, especially for the children, who need extra protein, energy, iron and vitamins for growth. They now understand that local vegetables are not just poor people's food, but a good and cheap source of essential nutrients. Cooked with palm oil or oil-rich groundnuts, the vegetable relish adds nutritional value and variety to the diet and helps to keep both children and adults well fed and healthy.