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Mali: Trees for Food Security

Life in the sandswept Sahel of West Africa is a year-long quest for food security. The region is plagued by annual droughts that last nine months, by periodic droughts that may last several years. People from Chad in the east, across to the Atlantic coast of Senegal in the west, have learned to make the best of the resources that nature has bequeathed them. They leave scattered trees in their fields of sorghum, millet and maize, an agroforestry system known as 'parklands'. If crops fail, or during the long dry seasons, the trees provide them with many of their nutritional needs.

So it is not surprising that when researchers set out, using the priority-setting methods outlined above, to find out what trees people most value and why, they found that people in the Sahel most value trees that provide food security and generate some income. The priority-setting exercise was carried out by ICRAF scientists from the Canadian-funded Semi-Arid Lowlands of West Africa programme, together with their partners in national agricultural research organizations. Their surveys took them through Niger, Mali, Burkina Faso and Senegal, and the list of the top five trees in each country showed some striking similarities.

Baobab appears in the list in each country; it tops the list in three countries. Its fruit pulp is used for porridge-making and for flavoring drinks. It is extremely high in vitamin C, an added bonus in an area where this vitamin is chronically lacking. The leaves, high in vitamin A, are used in sauces. These products are used at home and also sold to generate income.

Another top-rated tree is *Vitellaria paradoxa* (karité in French, sheanut in English). Karité produces an oil or butter used in cooking and as a cosmetic, which is the main ingredient in many of the most expensive facial cremes on the international market. In Burkina

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Baobab trees. (ICRAF)

A Lethal Cocktail for the Chickpea Podborer

Dead crushed larvae of the podborer pest, well mixed with water and a stabilizer, yield a lethal cocktail used by Indian farmers to spray their chickpea fields.

A forty percent increase in chickpea yield was achieved by a group of

ICRISAT

farmers developing this new biological pesticide in collaboration with the International Crops Research Institute for the Semi-Arid Tropics (ICRISAT) based near Hyderabad.

The podborer, the caterpillar of the insect Helicoverpa Armigera, used to destroy over half the earlier harvests of chickpea, the most important post-monsoon crop in the Medak district of Andhra Pradesh.

The farmers contacted ICRISAT, a center supported by the Consultative

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Sida's Strategies for Natural Resources and the Environment

By Johan Holmberg

Important changes in the global development paradigm are reflected in the recent priority setting exercise of a major donor agency. CGIAR News is reprinting this analysis with the kind permission of Development Today, Oslo.

The work of the Swedish International Development Cooperation Agency (Sida) in the area of natural resources and the environment should be seen in the context of four policy papers adopted during 1996 and 1997 in the areas of sustainable development, poverty, gender equity, and human rights and democracy.

These policy papers are closely aligned with the politically established objectives for Swedish development aid and set a framework for all of Sida's operations.

It is the paper on sustainable development that is of most direct relevance to Sida's work with natural resources and the environment. It specifies that priority should be given to five subject matter areas and two cross-cutting methodological approaches, namely: water resources management; sustainable land management, including soil conservation; the marine environment; the urban environment; environmentally sound production and consumption of energy; capacity building and institutional development; and NGOs and civil society.

But what became of agriculture and forestry, subsumed above under "sustainable land management?" And what about fisheries? Sweden was very much part of the trend in the aid donor community in the late 1980s and early l990s when aid to agriculture declined as the combined result of political pressure for environmental action and disillusion with the performance of aid to agriculture, primarily in Africa.

It is therefore reasonable to ask whether this remains the predominant view. Is it reflected in the aforementioned priorities of Sida's work with natural resources?

The short answer is no. There is a gradual shift under way back to agriculture in Sida's cooperation with African countries. In 1995 Sida commissioned a major review of its possibilities to contribute more effectively to African food security. The report, available in mid-1996, recommended that Sida strengthen its professional presence in Africa in fields related to food security. It also recommended more support to decentralized programs to tackle issues related to productivity in smallholder agriculture.

In 1995 Sida commissioned a major review of its possibilities to contribute more effectively to African food security.

Major programs in this area are now in various stages of planning in Tanzania, Ethiopia, Angola and Mozambique. These are all area-based programs with several different components designed to address the multiple needs at farm level. They resemble the integrated rural development programs of the 1970s. But there are major differences. The new programs set out to strengthen the local government administrations instead of creating separate organizations. They are based on a bottom-up planning approach where priorities for intervention are determined by the beneficiaries. They use low quantities of imported farm inputs and more emphasis on locally produced, improved seeds. They all have significant components of agricultural research.

In addition, support to international agricultural research through CGIAR is Sida's single largest research program. There are signs that this support may increase further in future years.

So what has changed? Why does Sida now consider conditions for success in agriculture to be more propitious in Africa than in the 1980s? First, with structural adjustment many of the economic distortions discriminating against agriculture have now been removed. Economic incentives now

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Sida's Strategies

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exist for farmers to grow more food. Second, there is the belief that food security in Africa is an issue that needs to be tackled head-on and that improving the environment in rural areas is not sufficient to increase farm productivity. Third, many of the components of these programs, such as strengthening local government institutions, gaining knowledge through research, and improving rural roads, are prerequisites for future agricultural productivity increases. And fourth, there is increasing realization that more support to agricultural research is a necessary, albeit insufficient, precondition for future food production increases.

Interestingly, the development has been similar in forestry, previously considered one of the high-profile areas of Sweden's development assistance. It is Sida's experience that to reduce deforestation rates, support to improved agriculture and security of tenure is often likely to be more effective than direct forestry assistance. That has lead to a gradual disappearance of separate forestry projects. They are being integrated into programs for natural resource management that emphasize agricultural extension, provision of water and credit facilities. Examples of programs where this development has been evident are found in Vietnam, Laos and India.

Support to fisheries development by Sida has almost ceased, as the last project is being phased out in Angola. This is being replaced by an interest in coastal zone management, and a review of Sida's work in this area is under way.

An important new priority area for Sida is water resources management. In 1996 Sida took an initiative in southern Africa with a focus mainly on capacity building and awareness raising for water development. There is a long Swedish experience in the area of rural water supplies and sanitation with successful projects in several countries, including Botswana, Zimbabwe, Tanzania, Kenya, Laos and India.

In 1996 Sida decided to host the secretariat of the Global Water Partnership (GWP), a network of organizations interested in the sustainable development of water resources in developing countries co-sponsored by the World Bank and UNDP. The network is active in all fields within the water sector, not only rural water supplies, and hence forces Sida to broaden its expertise. With the Stockholm Water Symposium already one of the major annual scientific conferences on water in the world, the planned creation of the Stockholm International Water Institute to administer the Symposium and to conduct research, and the Stockholm Environment Institute already active in this area, Sida's involvement in GWP will contribute to raising the Swedish profile in water resources development.

Swedish development assistance is declining and will in 1997 be 0.7 per cent of GDP, the lowest since 1974. In many areas Sida is now cutting back its programs and staff. However, the government's parliamentary bill directing Sida's work in 1997 singles out natural resources management as the only sector (in addition to democracy and human rights) where Sida's programs should increase in scope. In 1995/96 this sector accounted for 13 percent of Sida's disbursements, and it has remained at that level for the last four years. When the programs now being planned have reached maturity in a few years, this percentage should increase substantially reflecting economic realities in many of the traditional Swedish aid recipient countries.

Johan Holmberg is Director of the Department of Natural Resources and Environment at Sida, and Executive Secretary of the Stockholm-based Global Water Partnership.

Groundwater Sales Promote Equity

In Pakistan, as in other countries in South Asia, farmers who can afford it are investing in private tubewells to assure a supply of irrigation water when they need it. When these farmers have more water than they can use, they sometimes sell the excess to nearby relatives and neighbors. Until now, these informal water markets have received little research attention. But, as water becomes more scarce and degraded, countries need information to formulate policies that improve access to water resources, particularly for tenants and smallholders. "Groundwater Markets in Pakistan: Participation and Productivity," IFPRI Research Report 105 by Ruth Meinzen-Dick, looks at how water markets operate, who participates, the nature of the transactions, and the effects of the markets on agricultural productivity and incomes. Its findings are relevant throughout South Asia.

Private tubewells boost production by increasing farmers' control over the amount and timing of irrigation applications, which not only improves yields but allows farmers to switch to higher-value crops, thus increasing income. In Pakistan, farmers with more than 25 acres are most likely to own a tubewell, whereas farmers with less than 10 acres are usually the buyers of groundwater. In Punjab and North-West Frontier Province, the study area, 15 percent of the farmers owned tubewells. About one-third of the owners (5 percent of the total sample) sold water, at least occasionally, and 30 percent bought water. The report finds, however, that policies to encourage those with middle-sized farms (10 to 25 acres) to invest in tubewells might improve equity, because such farmers may not use all of the water on their own acreage, as large farmers often do, and they are more likely to be able to finance a well

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PERSPECTIVES

Bangladesh: Rice is Life

The demand for rice is constantly rising in Bangladesh with nearly 2.3 million people being added each year to its population of about 120 million. Rice production increases must be achieved at a faster rate than in most other countries, while the land planted to rice is not expanding. In addition, Bangladesh is faced with production constraints such as drought, lack of irrigation facilities, flooding and salinity of soils, coupled with fluctuating commercial rice prices.

Yet, rice is central to Bangladesh's economy and agriculture, accounting for nearly 18 percent of the Gross Domestic Product (GDP) and providing about 70 percent of an average citizen's total calorie intake. The rice area totals about 10 million ha and accounts for 75 percent of the total area of agricultural crops, and 93 percent of the total area planted to cereals. The rice sector is by far the most important provider of rural employment.

Due to the increase in population, the average farm size has declined from 1.43 ha in 1961 to 0.87 ha in 1994. The average rice yield remains low at about 2.7 t/ha. Although substantial rice production growth was achieved during the 1976-93 period, growth since then has been negligible. This is mainly due to continued drought in most areas and excessive monsoon flooding in parts of the country.

Future growth in rice production will have to come from expansion of irrigated areas, use of new high-yielding varieties, more fertilizer input, and improved crop management practices.

To achieve such growth, a key factor will be research carried out in collaboration with the International Rice Research Institute. Bangladesh's research link with IRRI goes back more than 30 years. In 1966, the government of what was then East Pakistan emphasized rice research within the Cereals Section of the Agricultural Research Laboratory Tejgaon, Dhaka, and began collaborative research to test rice lines from IRRI. In 1967, IR8, the first widely distributed semidwarf rice variety, was introduced into the country.

To achieve such growth, a key factor will be research carried out in collaboration with the International Rice Research Institute.

In 1970, the Bangladesh Rice Research Institute (BRRI) was established and has worked closely with IRRI ever since. Current areas of collaboration include:

- Safeguarding and preserving the biodiversity of the genepool
- Evaluating rice germplasm
- Resource management in the coastal wetland ecosystem
- Enhancing rainfed lowland rice productivity in the rainfed lowland areas
- Projecting rice supply and demand
- Evaluating rice seed health
- Nitrogen supply in rice-wheat systems
- Developing hybrid rices.

To maintain self-sufficiency in rice, Bangladesh will have to continue to expand rice production by raising yields at a rate that is at least equal to population growth until the demand for rice has stabilized. Although the population growth

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ANNOUNCEMENTS

- The new Chair of the ICRAF Board of Trustees is its former Vice Chair, Yemi Katerere, a Zimbabwean forester who is Regional Director of IUCN for Southern Africa and a Director of the International Society of Tropical Foresters.
- Enrico Porceddu, Professor of Agricultural Genetics, University of Tuscia, Italy, will be the Board Chair of IITA as of May 1, 1997.
- Shawki Barghouti has been selected for the position of Director General of ICRISAT. A native of Jordan, he is currently Chief of the Agriculture and Water Operations Division, South Asian Country Department of the World Bank. He will succeed James G. Ryan on September 1, 1997.
- FAO initiates a program of cooperation with academic and research institutions. FAO promotes collaboration with academic and research institutions by giving assignments of up to one year for research or study at FAO Headquarters or in the field. Visiting experts have consultant status, and FAO covers the basic costs of their assignment. Some 60 scientists have either completed or are continuing their assignments, and 160 more have expressed interest. Currently, some 20 countries and 4 regional and international organizations are participating. A 19-page list of priority areas for research collaboration is available from Mr. Ramadhar TCDC/ECDC, FAO Headquarters (Ramadhar@fao.org). (FAO)
- "Keeping World Food Security on the Agenda: Implications for the United Nations and the CGIAR" is the title of a booklet by Louise O. Fresco and Rudy Rabbinge, published by the CGIAR Secretariat in the Issues in Agriculture Series. The paper describes the changes needed to achieve the goals proclaimed by the 1996 World Food Summit: food security and access to food for all. Copies are available from the CGIAR Secretariat

NEWS

Does A Farmer's Choice of Products Affect Adoption of New Technologies?

Focusing research and agricultural extension services on farms of a particular size or type is unlikely to yield greater returns than treating all farms alike, according to "Role of Farm-Level Diversification in the Adoption of Modern Technology in Brazil," IFPRI Research Report 104, by Marc Nerlove, Stephen Vosti, and Wesley Basel. The report finds that a 1 percent increase in total output will generate a 1 percent increase in use of modern inputs no matter what combination of products is produced or how stable the mix. Supply constraints, particularly lack of credit, may largely determine whether a technology is adopted, and supply constraints affect almost all farms equally.

This report looks at how farmers' decisions about what crops or livestock to produce and in what proportions are linked to technology adoption. Since technologies are usually developed with certain crops in mind, a farmer's decision to grow that crop may mean that he will adopt new technologies as well.

Conducted in the poor but agriculturally diverse Zona da Mata region of Minas Gerais, Brazil, the study uses statistical cluster analysis to identify farms by their product mix. Farms, assigned to groups according to the share of farm output devoted to a particular product, are divided into five categories: farms that produce coffee, corn products, dairy products, and rice; off-farm labor is the fifth category. These categories serve as a basis for examining the factors that influence adoption of new technologies such as the size and scale of operation of a farm, its expenditure on modern inputs, its degree of specialization (the diversity of its agricultural products), and the quality of its land. Despite varying agroecological conditions, farmers can readily change their product mix among coffee, corn, and dairy products, and off-farm labor, but rice requires flat, irrigated land.

The study finds that farmers' decisions about changing product mix are influenced by price policies and the agricultural extension services available, which vary from product to product. Many farmers in the Zona da Mata grew coffee because input and output prices were subsidized and preferential credit terms were available. The size and timing of investments and returns for different products also influenced farmers' choices.

The study also looks at the long-term stability of product mix. Thirty-five percent of the farms were stable, staying in the same cluster for six years; 31 percent were marginally stable, changing clusters only once in a single year; and 29 percent were "jumpers," switching from one cluster to another during the period. Farmers who maintained a stable product mix or jumped to coffee production tended to be better off than the other farmers. But even the poorest farmers showed a willingness to make changes in response to economic and other incentives.

(IFPRI)

RESEARCH HIGHLIGHTS

Diversity by Design

By Larry Harrington

Our common goals

There are a number of reasons for fostering diversity in agroecosystems. More diverse systems take better advantage of ecological niches. Species adapted to different stresses (e.g., waterlogging, soil acidity) can be positioned where they have a comparative advantage. Greater system diversity can also improve stability and resilience. Diverse agroecosystems offer multiple pathways for energy and nutrient cycling; consequently system productivity is not held hostage to the performance vagaries of any particular species. When properly designed, more diverse systems also can reduce problems associated with pests, diseases, and weeds and can decrease reliance on external inputs. Such diverse systems may also be associated with in-situ conservation of foodgrain land races and folk varieties.

However, agroecosystem biodiversity is not an end in itself but a means of achieving productivity, stability, resilience, improved environmental quality, and the conservation of crop genetic diversity. These in turn are part of larger societal goals—sustainable food security, reduced poverty, and improved public health.

Societies also value natural biological diversity in the broader sense. People are concerned about the possible extinction of species because of their potential future benefits, their role in ecological balances, and simply because people place a value in their continued existence, regardless of future human benefits.

Kinds of diversity

Agroecosystem biodiversity can be understood in several different ways:

Crop genetic diversity. This embraces such factors as varietal concentration; pace of varietal change over time; genetic similarity among major cultivars; the conservation and pyramiding of favorable genes in breeders' varieties; the conservation and use of impor-

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tant genes present in folk varieties, land races, and wild relatives; and opportunities for expanding crop genetic diversity through wide crosses and biotechnology.

Crop species diversity over space. Spatial species diversity may be exceedingly narrow (e.g., a monocropped rice field) or exceedingly broad (e.g., a home garden featuring simultaneous cultivation of fruit trees, banana plants, coffee, spices, and several food crops). Plots with low species diversity and high species diversity often are found within the same farming system.

Crop species diversity over time. Temporal species diversity may be narrow (e.g., one maize monocrop crop per year, every year); broad within a year (e.g., an annual sequence of multiple cropping involving cereals, legumes, and horticultural crops); or broad over several years (e.g., rice-potato-wheat patterns, broken every few years by a sugarcane crop). Crop species diversity over space and over time are not necessarily related.

Agroecosystem biodiversity through crop-livestock interactions. The presence of livestock in a system tends to greatly enhance the value of non-crop components (crop residues, grazing lands, forest resources) and typically features nutrient cycling between rangeland and crop land, thus fostering improved productivity and sustainability of cropping systems and a higher potential for spatial and temporal crop species.

Natural biodiversity within agroecosystems. More diverse agroecosystems—particularly those with greater spatial diversity, and those with trees—may provide habitat for a wider array of wildlife.

Natural biodiversity as indirectly affected by agroecosystems. Highly productive agroecosystems can indirectly foster natural biodiversity by making it unnecessary to farm marginal or fragile areas, or to clear new forest areas for agriculture. System diversity may be broadened by increasing crop genetic diversity, expanding crop species diversity over space and time, fostering crop-livestock interactions, or improving productivity in favored agricultural areas to protect biologically diverse fragile, marginal, or forested areas from agriculture.

Sustainability in perspective

Partly because they are thought to be closely linked to issues of biological diversity, sustainability issues are commanding more attention from agricultural scientists. Many agree that the ability to quantify sustainability is fundamental to making the concept useful. Unfortunately little progress has been made in this regard.

Most commonly, indicators of sustainability are narrowly driven by definitions. This often leads to arguments that are merely circular. For example:

- If agroecosystem sustainability is defined in terms of zero external input use, then any technical change leading to reduced external input use can be said to foster sustainability.
- If agroecosystem sustainability is defined in terms of low levels of environmental pollution, then any technical change leading to less environmental pollution can be said to foster sustainability.
- If agroecosystem sustainability is defined in terms of high agroecosystem biodiversity, then any technical change leading to higher agroecosystem biodiversity can be said to foster sustainability.

If agroecosystem sustainability is defined in terms of local self-reliance in agricultural production (i.e., avoidance of international markets), then any technical change leading to greater local self-reliance can be said to foster sustainability.

All of these definitions, and their corresponding indicators, are inadequate—even when combined. They emphasize the plot or farm community level of analysis, ignoring higher levels. They succumb to the "fallacy of scale," in which something that appears unsustainable at one level of analysis may be a strong element in favor of sustainability at a higher level.

An example of "fallacy of scale"

Green Revolution technologies for rice and wheat in South Asia often have been criticized as unsustainable. At the agroecosystem level, these technologies may feature low species diversity, high reliance on external inputs and energy sources, and environmental pollution from pesticides and fertilizers. However, at higher levels of analysis, the diffusion of Green Revolution technologies in parts of South Asia has been associated with accelerated economic development in Bangladesh; higher incomes through employment generation in Uttar Pradesh; improvements in income distribution in Pakistan; reduced population growth in Green Revolution areas of India—and, not least, the saving of approximately 40 million ha from the plow (or woodcutter's ax) in India alone. Without the Green Revolution technologies, India would have needed another 40 million ha of rice and wheat area to meet foodgrain demand.

The Green Revolution played a virtually unrecognized role in reducing pressure to cultivate biologically diverse fragile, marginal, or forested areas. In the absence of the Green Revolution, food prices would have been higher, employment growth (especially off-farm employment) would have been slower, poverty more widespread, and population growth more rapid—exacerbating the threat to natural biological diversity.

So, at a higher level of analysis, resource degradation and environmental pollution in Green Revolution areas has been a cost associated with defusing longer-term threats to resource quality and natural biological diversity in biologically diverse fragile, marginal, or forested areas. Researchers and farm-

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ers must reduce this cost. Plot-level threats to sustainability in Green Revolution areas must be addressed. The challenge is to generate a "doubly green revolution" that maintains the powerful and favorable indirect consequences of highly productive agricultural technology, while improving resource quality and reducing pollution. Sustainability is not enough—productivity must increase as well.

Diversity by design

Greater agroecosystem biodiversity—particularly crop genetic diversity and spatial and temporal species diversity—often can help achieve sustainable improvements in agricultural system productivity. How, then, do we foster widespread use of more biologically diverse agroecosystems? There are at least two ways:

- Diversity by design—Researchers and farmers design more biologically diverse agroecosystems, which are widely adopted by farming communities. This process includes participatory research on indigenous technical knowledge about system diversity, with a view to extrapolating such knowledge to comparable areas.
- Demand-led diversification—Higher incomes and reduced poverty generated by more productive agricultural practices shift the structure of food demand towards a more diverse array of products, such as fruits, vegetables, and animal products. Farmers follow market signals and diversify their farming systems.

The path of "diversity by design" is direct. It is the path taken by cropping systems and farming systems research (FSR). In Asia such research sought to diversify and intensify cropping patterns by introducing a second non-rice crop into rice-based systems (an alternative made possible by the introduction of short-duration, non-photoperiod sensitive rice varieties). In Africa, the emphasis has been less on intensification and more on reconciling food security and system sustainability requirements. Even in Africa, however, diversity has been a major theme in FSR. "Diversity by design" also has been characteristic of research on agroecology.

The lessons learned from FSR and research on agroecology have vastly improved researchers' capacity to work with farmers in understanding and improving farming systems. However, these lessons have not led to widespread adoption of more diverse, productivity-enhancing resource-conserving agricultural systems. Work is urgently needed to improve the effectiveness of research (measured by widespread adoption) aimed at designing such agricultural systems. Until then, the path of "diversity by design" is unlikely to help achieve our common goals.

Demand-led diversification

The path of "demand-led diversification" is relatively indirect but has induced widespread change in farming systems, particularly in Asia. Indonesia provides a classic example. Increased rice productivity in favored lowland areas expanded the supply of rice and reduced its price. Marginal rice areas, often on hillsides, became unprofitable and farmers in these areas ceased producing rice. However, higher incomes in rural and urban areas—largely resulting from improved rice productivity and lower rice prices—shifted the structure of demand for food towards fruits and vegetables. Partly as a consequence, farmers in hillside areas switched from growing rice to perennial fruit trees. The same process is evident in other areas where new technology has increased the productivity of basic grain production, for instance in the Indian Punjab.

In contrast, stagnating grain (maize) productivity in southern Africa provoked a chronic food security crisis, the expansion of maize cultivation into wildlife areas, and a relative absence of market signals that would induce farmers to diversify into cash crops. Not by coincidence, "diversification out of grain production" is not high on the southern Africa research and policy agenda.

Success in demand-led diversification is sensitive to the policy environment, requiring:

- an overall policy environment that encourages more flexible and broader cropping systems rather than commodity-support programs;
- laws and institutions that facilitate efficient marketing by establishing grades and standards for different commodities and developing and distributing farm inputs;
- public investment in physical and social infrastructure, communications, and information systems; and a rural financial system that mobilizes rural savings, makes credit available to traders, and diversifies the rural economy; and
- training and education to prepare rural people for non-agricultural jobs.

Demand-led diversification will lead to more biologically diverse agroecosystems at the aggregate (e.g. regional) level but may not ensure increased biodiversity at the plot or farm level. Moreover, plot-level trends in resource quality, external input use, and environmental pollution may increase or decrease, in accordance with practices adopted as farmers learn to manage a new set of enterprises. The path of "demand-led diversification," on its own, also may not lead to the attainment of our common goals.

Complementarity and competition

As noted earlier, the goals of sustainable food security, reduced poverty, improved public health, and conservation of natural biological diversity will be attained through widespread use of more productive, stable, resilient

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agroecosystems and the conservation of crop genetic diversity.

This will require an emphasis on sustainable productivity improvement in favored areas—to reduce pressure to cultivate biologically diverse areas unsuited to agriculture, foster "demand-led diversification," and lead to the "doubly green revolution" described previously.

Agricultural research and development—scientists, extension workers, farmers, and policy makers—can help through: cereal varieties that are more tolerant to biotic and abiotic stresses and use nutrients more efficiently; productivity-enhancing resource-conserving crop management practices such as integrated pest management (IPM) or reduced tillage; and more effective "diversity by design" through adoption of new cropping patterns, farming systems, and land management systems (featuring staple cereals) that capitalize on the advantages of system diversity to sustainably improve productivity.

Sustainable productivity improvement in marginal, fragile areas—acknowledging that we can reduce but not eliminate pressure to cultivate biologically diverse areas unsuited to agriculture—would again require varieties, crop management practices, cropping patterns, farming systems, and land management systems that can offer leverage points.

As "demand-led diversification" takes hold, scientists, extension workers, farmers, and policy makers must foster sustainable management strategies. A greater temporal and spatial diversity of enterprises does not necessarily imply improved sustainability. New fruit and vegetable crops can exacerbate or ameliorate problems of erosion, soil fertility loss, water-induced land degradation, external input dependence, or environmental pollution.

In the end, it is not a case of competition, but of complementarity. It is not a case of "Green Revolution" vs. "alternative agriculture," or "diversity by design" vs. "demand-led diversification." We must use all of the tools at our disposal—following all promising paths—to reach our common goals.

Larry Harrington is Manager, Natural Resources Group, CIMMYT.

NEWS

Bamboo Keeps Growing in China

A joint study by the Chinese Academy of Forestry (CAF), the International Network for Bamboo and Rattan (INBAR), and CIFOR has examined the impacts of national policy changes on the bamboo sector in Anji County, Zhejiang Province, where bamboo has a long tradition and is important in the local economy. The purpose was to investigate the potential contribution of bamboo cultivation, harvesting and processing to rural development, given an appropriate policy and economic environment. The project has compiled general county-level information and details on 200 households and dozens of industries.

Preliminary analysis shows that a series of policy changes have cleared the main bottlenecks in the sector, providing the incentives and opportunities to intensify production of raw material with little increase in land area, and to diversify production towards increased shoot output. Because the changes were implemented gradually, and frequently tested on a small scale, major disruptions have been avoided. Success and a smooth transition have been facilitated by a sequence that has moved initially from reforming the production of raw material to subsequent changes in marketing, processing and foreign trade. The bamboo sector is currently experiencing a big expansion in China to meet the demand of both its huge internal market and increasing exports. The next stage in the research will try to characterize different situations by selecting important bamboo production counties ranging from the more developed Zhejiang in the east to the central province of Hunan, to the western, less-developed province of Sichuan. The general situation in the counties is characterized by an unmet demand for raw bamboo resources from different processing industries, leading to intensification and, wherever possible, expansion of bamboo plantations. The private management of bamboo under the "household responsibility system" is now well established and the industry is working under a basically market economy system, with some checks and balances from the State.

Each county displays special features related to the extension, type and intensity of bamboo management and, even more so, to the type of associated processing industry. Daoming township (Sichuan province) produces bamboo mainly for labor-intensive handicrafts. It is grown mostly around farmers' houses. In Muchuan (Sichuan province), severely degraded slopes have been recovered by planting bamboo and the product is mainly used for pulp and paper. Bamboo area has increased 400 percent in 15 years. Policies to encourage intensification, coupled with long-term contracts under the household responsibility system, have promoted the planting of bamboo in place of Chinese fir in Taojiang county (Hunan province). One of the areas with the highest income from bamboo is Linan county (Zhejiang province) which specializes in bamboo shoot production. Average yearly household income from bamboo shoots, in villages specializing in bamboo shoots, amounts to US$2,500, with some above US$10,000. By examining the situations in each of these counties, the project seeks to characterize the favorable conditions which improve the livelihoods of the Chinese bamboo farmers and expand the possibilities for their bamboo production.

(CIFOR)

Better Trials...from the Scrapyard

By Mike Robbins

It started with Hassan Ouabbou of France's Institut de la Recherche Agronomique (INRA). Some time ago he travelled around Morocco with cereals plant physiologist John Peacock of ICARDA. The two men talked long and hard about the problems of breeding wheat for heat stress. Hassan Ouabbou was at that time working on his PhD thesis at Kansas State University in the United States. It was titled *Physiological aspects of recovery and evaluation of wheat during high temperature stress*, an appropriate field for a scientist in a country where drought and heat can be devastating.

Ouabbou, who is in the Agronomy Department at INRA's regional center at Settat, described how, in certain conditions, growth in cereals completely stopped at the grain-filling stage. It was not clear why. What was needed was a way of simulating heat stress so that the problem could be studied and sources of resistance found.

The challenge had a familiar ring to it. John Peacock had been working on the simulation of heat stress and its effects on seedling development. In some conditions, seedling development simply stopped, and Peacock wondered what was really happening. He had got together with ICARDA engineer Peter Eichhorn and Mahalakshmi, a visiting scientist from ICRISAT in India, and together they modified a system which Peacock had developed earlier at the University of Arizona for subjecting seedlings to this type of stress.

These experiments, and earlier ones in Arizona and India, proved successful. "What we found was that heat shock prevented the products of photosynthesis from reaching the root system," he explains. "Put simply, a plant has two basic parts to it. One is the source and the other is the sink. The source develops energy; the sink uses it. In extreme heat, the products— carbohydrates— find their journey between source and sink blocked, possibly by proteins which coagulate in the phloem as a result of the high temperatures and block the sieve plates.

"The circumstances under which this coagulation occurs is genetically governed. This means that we can look for sources of resistance; that is, either a higher coagulation temperature or something that stops blockage."

While doing this research, Peacock found that the principle of growth stopping because of a blockage between source and sink had a long time ago been described by others. "Cut a ring of bark off a tree and it will die, but not at once. That's because the bark provides a route between source and sink. When it is removed and the route is blocked, the tree roots starve and eventually die. Before that happens, a bulge will develop at the edge of the cut bark. That's the products of photosynthesis trying to get through.

"This phenomenon was, in fact, observed by Marcello Malphighi in 1675 and by the father of modern plant physiology, Stephen Hales, in 1727. Perhaps we should use the indigenous knowledge of the scientific community..."

The stimulus for the next move came from Ouabbou. If it had been possible to simulate heat-stress in seedlings, and find out why their growth was stopping, could not the same be done for the grain-filling stage? The problem was that Morocco, and the other North African countries, had a special constraint, the sirocco.

"We're not just talking about heat here," says Peacock. "Hassan and I wondered if the aridity of this wind was a factor. It's important to find out, because there are at least two stresses that could be stopping the growth at that stage. We need to know what it is, so that eventually we will be able to map genes for thermotolerance."

The first possible cause would be overheating of the leaves and their photosynthetic apparatus. "What happens is that a combination of heat and aridity could disrupt the plant's cooling system. The plant then stops producing energy or photosynthates.

"But what about, again, a blockage between source and sink?"

When the plant reaches the grain-filling stage, explains Peacock, the head which is producing seeds is now the sink and there is a heavy demand for the 'fuel supply'. It is possible, he says, that once again the proteins are coagulating because of sheer heat stress, accentuated by the failure of the plant's air-conditioning system.. "If this is the case, the aridity of the sirocco is not a factor. The only way to find out is to perform trials in the field which test for performance under heat *and* wind *and* aridity." Hence the need for a machine which could simulate heat, wind speed and relative humidity. In the field!

The problem was put to Peter Eichhorn, who built a prototype. Hassan Ouabbou came from Morocco to assist with its development. They were joined by Mohamed Iskandar from Egypt; an agronomist, who carries out research for the Egyptian national program in the Northern Sinai. Egypt also faces fierce onshore winds between Marsa Matrouh and El Arish. His visit was arranged by ICARDA's Nile Valley and Red Sea Regional Project (NVRSRP).

The four-man team made some modifications to the original machine. Hassan Ouabbou wanted a machine that would function in the field. The design that emerged burns diesel-oil to heat water, which is then circulated through a truck radiator. A truck fan driven by an electric motor blows through this and sends a pretty good sirocco down through a plastic tunnel, in which a sprinkler system is calibrated to simulate different levels of relative humidity. Electricity is needed to run the electric motors for the fan and circulation pump, but the power consumption is low, so that a small generator can be used to run one or more machines in the field.

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Information Needs of Small Scale Farmers in Africa: The Nigerian Example

By Vincent Nnamdi Ozowa

Over the years, deliberate, though ineffective efforts have been made by donors and African countries to bring about agricultural development without much to show for it. Much of the failure can be attributed to the adapted transformation approach to agriculture which is characterized by the introduction of a wide variety of large scale farming and processing technologies. It is however gratifying to note that there is now a shift in emphasis from the big scale transformation approach to the small scale improvement strategy approach which is attuned to African age-long farm practice.

The failure can also be attributed to the treatment of information delivery as a matter of course by most African governments. As often happens, agricultural information is not integrated with other development programs to address the numerous related problems that face farmers. Information is an essential ingredient in agricultural development programs but Nigerian farmers seldom feel the impact of agricultural innovations either because they have no access to such vital information or because it is poorly disseminated. The information provided is exclusively focused on policy makers, researchers, and those who manage policy decisions with scant attention paid to the information needs of the targeted beneficiaries of the policy decisions. The non-provision of agricultural information is a key factor that has greatly limited agricultural development in developing countries.

If the approaches to agricultural development programs are to work, African governments need to take new approaches to information dissemination and management that grow out from a clear understanding of what farmers information needs are.

Nigerian farms are classified into small scale, medium scale and large scale. When judged by international standards whereby all farms less than 10.00 hectares are classed as small, then 94.37 percent of all farm holdings in Nigeria in 1973/74 (or 28 million holdings) must be classified as small scale farms while the remaining 5.63 percent or 1.7 million are medium scale holdings.

A small scale farmer depends on his efficiency in the utilization of basic production resources available to him or her. He/she makes a significant and important contribution to the national product, i.e. 99 percent of total crops output. The small scale farmer is the main producer of 98 per cent of the food consumed in Nigeria with the only exception of wheat.

Experience has shown that small farms outyield large farms on calorie output per hectare and are therefore more efficient. Even though small scale farmers' accessibility to agricultural innovations is often limited by unfavorable economic, socio-cultural and institutional conditions, they have achieved some level of efficiency through deployment of their indigenous knowledge. If provided with the right inputs, feasible technology and relevant information, they are capable of transforming traditional agriculture.

Information Needs of Small Scale Farmers

No one can categorically claim to know all the information needs of farmers especially in an information dependent sector like agriculture where there are new and rather complex problems facing farmers every day. It is safe to assert that the information needs of Nigerian small scale farmers revolve around the resolution of problems such as pest hazards, weed control, moisture insufficiency, soil fertility, farm credit, labor shortage, soil erosion and so forth.

The information needs may be grouped into five headings: agricultural inputs; extension education; agricultural technology; agricultural credit; and marketing. Modern farm inputs are needed to raise small farm productivity. These inputs may include fertilizers, improved variety of seeds and seedlings, feeds, plant protection chemicals, agricultural machinery, and equipment and water. An examination of the factors influencing the adoption and continued use of these inputs will show that information dissemination is a very important factor. It is a factor that requires more attention than it now gets.

Extension Education

The general lack of awareness among small scale farmers can be attributed to their high level of illiteracy. This contributes to the low level of adoption of agricultural production technology.

Extension is a type of education which is functional rather than formal. It is better provided by extension workers whose main task is to convey information in a meaningful form to farmers. One of the ways they do this is by training a group of model farmers with the hope that such farmers come in contact with other farmers. This "trickle down effect" is particularly necessary because farmers outnumber available extension workers with the present ratio of 1:3000.

Agricultural Technology

Agricultural technology for the small scale farmer must help minimize the drudgery or irksomeness of farm chores. It should be labor-saving, labor-enhancing and labor-enlarging.

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Information Needs

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The farmer needs information on production technology that involves cultivating, fertilizing, pest control, weeding and harvesting. This sort of information is at the moment being diffused by extension workers, other farmers, government parastatals and agricultural equipment dealers. The impact is yet to be felt.

Agricultural Credit

Agricultural credit encompasses all loans and advances granted borrowers to finance and service production activities relating to agriculture, fisheries and forestry and also for processing, marketing, storage and distribution of products resulting from these activities.

Small scale farmers are among the potential beneficiaries of agricultural credit in Nigeria but because of their low level of literacy they are mostly unaware of existing loan facilities. To reap the benefit of credit, farmers need information relating to sources of loan such as names of lenders, location and types of existing credit sources. They need information on the terms of loans such as the interest rates, loanable amount and mode of repayment.

Information regarding agricultural credit gets to small scale farmers usually through channels such as relations, friends, neighbors, government officials, commercial and credit banks. Grassroot organs such as village heads and local government officials are used to diffuse such information because of their personal touch with small scale farmers. Extension agents need to intensify their efforts in educating farmers to increase their level of awareness.

Marketing

All business activities involved in the movement of commodities from production to consumption is marketing. The farmer's market information needs are those that enable him make rational and relevant decisions. Market information services have the function of collecting and processing market data systematically and continuously, and of making it available to market participants in a form relevant to their decision making. Market information needs of small scale farmers include:

- Information on product planning. This is information on what crop and variety to grow at a given season with marketability of such a crop as an important deciding factor.
- Information on current prices.
- Information on forecast of market trends. This type of information assists farmers in planning their market products.
- Information on sales timing. This assists farmers in ensuring that they do not cause a market glut. It enables them to stagger harvesting and quantity for marketing.
- Information on improved marketing practices. It includes information on improved harvesting methods. This information is disseminated by field level extension workers by demonstration on farmer's fields, at local and wholesale markets.
- Information on group marketing. This enables small scale farmers to have organized sales of marketable surplus and bulk transport of produce.

In Nigeria, agricultural market information to small scale farmers is provided by the Ministry of Agriculture through the field level extension workers and by the broadcasting media. A lot still has to be done in this area. Some of those in charge of market information are not trained for the job.

Small scale farmers are among the potential beneficiaries of agricultural credit in Nigeria but because of their low level of literacy they are mostly unaware of existing loan facilities.

Agricultural Information Dissemination

Within the past two decades there has been a burst of research activities in the area of agriculture in Nigerian universities and agricultural research centers located around the country. Far reaching innovations that are capable of boosting the small scale farmer's agricultural production and Nigeria's economic development have been discovered. The yam minisett technique, protein rich soyabean production and utilization techniques, production and use of animal vaccines and drugs and labor saving devices are some of the many improved agricultural innovations not properly diffused. Prominent among the agricultural centers are the International Institute for Tropical Agriculture (IITA), the National Root Crops Research Institute, the National Veterinary Research Institute and the three universities of agriculture.

Unfortunately, most of the these innovations do not reach the farmer's field. This is because the medium for information dissemination in use are not quite effective.

Present Situation

Institutional and governmental organs have been put in place to ensure that farmers get to know and adopt agricultural innovations relevant to their situations, e.g. the Agricultural Extension and Research Liaison Services (AERLS), the extension services of the Agricultural Development Project (ADPs), Ministries of Agriculture at both state and federal levels, Media Forum for Agriculture, Cooperative Extension Centres (CEC) of universities and public enlightenment units of the 18 agricultural research centers. These bodies serve as facilitators of agricultural messages by acting as communication departments.

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Information Needs

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They use media such as leaflets, newsletters, posters, exhibits, visual aids and radio programs in communicating agricultural information. Radio and television programs are popular although controlled by government with its attendant problems regarding the choice of programs.

Of all the existing channels of agricultural communication, Nigerian farmers rank extension highest in terms of providing credible information and advice, especially on agricultural technology. A major function of extension is to get the farmer into a frame of mind and attitude conducive to acceptance of technological change. The use of fertilizers, for example, is fairly widespread in the middlebelt region of Nigeria where information about fertilizers is well diffused. Even though the demand for fertilizers is buoyant, the supply is mostly inadequate to meet the demands.

Apart from the use of extension for diffusion of agricultural innovation, other channels like rural development field staff, contact farmers, school teachers, private sector agri-business people, staff of the Ministry of Agriculture and the electronic and print media are used. These channels have their strengths and weaknesses.

To strengthen the efforts of the print and broadcasting media in ensuring proper agricultural information dissemination to farmers, the Media Forum for Agriculture, was formed by media practitioners from all over Nigeria in 1989 with the aim of providing better support for agriculture by improving the quality of agriculture coverage in the media.

Again, the targeted audience is not properly reached as the main beneficiaries of information carried by the print and broadcasting media are urban elites.

Problems of Agricultural Information Dissemination

There are some limiting factors and apparent constraints in agricultural information dissemination in Nigeria, including status differences between extension agents and their clients; agents' inadequate knowledge of "how communication works"; lack of inter-agency cooperation both in program planning and implementation; and the extension's general lack of interest in traditional media.

One of the obvious constraints in the use of the broadcasting media in Nigeria is poor reception quality and the area covered. The messages carried are not tailored to the information needs of rural populations. Even when the information is relevant, it is seldom aired at the proper time and so does not get to the targeted audience.

Leaflets and newsletters as message carriers are of limited use in reaching illiterate farmers.

Another major constraint is the use of print media: Leaflets and newsletters as message carriers are of limited use in reaching illiterate farmers. Technical language used in communicating information is incomprehensible to the farmers.

Another major constraint to agricultural information dissemination is the inadequacy of existing extension programs. Some of these programs are conceived without well thought out plans and are prepared in a hurry without the farmers whose attitudes are to be changed making any input. Such agricultural information packages can neither sustain the farmers' interest nor effect the desired attitudinal change. Farmers' interests are disregarded even more as most of the agricultural innovations are written and broadcast in English instead of the local language. When local language is used, emphasis is often on the three major Nigerian languages Hausa, Ibo and Yoruba. These programs are broadcast when farmers are far away in the fields or too tired to listen after the day's toil. A majority of the farmers do not own radio sets.

Well intentioned agricultural programs can be marred by poor implementation and too much bureaucracy. For example, the Cooperative Extension Centre of the University of Agriculture, Makurdi, has a competent corps of subject specialists without adequate funding, facilities and logistic support like visual aids, equipment, transportation and adequate communication channels. As a result, the Centre has not been able to achieve the expected impact on the immediate university community.

The present ratio of 1extension worker to 3,000 farmers is inadequate for effective agricultural information diffusion. The problem is compounded by the paucity of women among extension agents especially in a society where cultural and religious taboos make it impossible for male extension workers to reach women farmers who outnumber male small scale farmers.

Many people in extension are ill-prepared for extension and an extension communication job. The emphasis in their training is more on technical proficiency rather than on rhetorical and persuasive skills. An extensionist trained in this way, is unlikely to make an impact on a conservative farmer who is not likely to put his farm inputs to risk by trying the extensionist's improved technique. There is real need for extension agents training to be relevant to their jobs at the grassroot.

V. N. Ozowa is Senior Librarian at the University of Agriculture, Makurdi, Nigeria. An earlier version of this article was published by the Quarterly Bulletin of the International Association of Agricultural Information Specialists IAALD/CABI (v. 40, no 1, 1995) which has given kind permission to reprint.

Podborer

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Group on International Agricultural Research (CGIAR), through the Deccan Development Society, a local non-governmental organization. Ten on-farm trials of alternative podborer control methods were conducted by farmers in Kappadu village, together with ICRISAT scientists.

The trials involved a conventional chemical insecticide, a botanical insecticide derived from the domestic neem tree, and the nuclear polyhedrosis virus (NPV), a natural enemy of the podborer. The NPV particles are ingested by larvae as they voraciously feed on the sprayed chickpea leaves.

"On-farm experiments have clearly shown the efficacy of this approach…"

The dying larvae are full of brown liquid which contains the virus particles and are collected for the cocktail which should be sprayed at sunset because the virus is inactivated by sunlight.

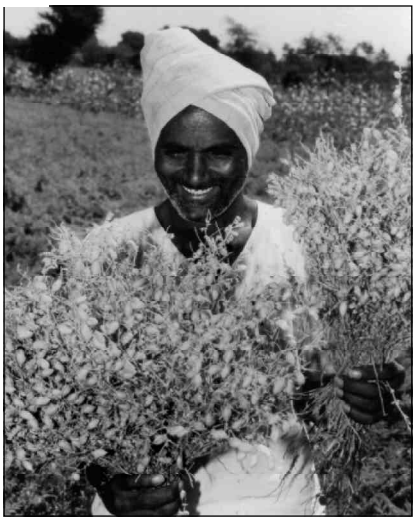
Vitthal R. Bhagwat is leading a team of ICRISAT entomologists that developed an integrated pest management package consisting of an improved chickpea variety, the botanical insecticide, and the NPV cocktail.

"On-farm experiments have clearly shown the efficacy of this approach," says Bhagwat of the new, eco-friendly and low-cost technology readily adopted by the farmers who had been trained to monitor pheromone traps, count the larval population per plant, and determine the right stage to apply the NPV. They learned how to mix the cocktail and decided to apply three sprays at weekly intervals.

"We did not believe when we were told about it but now we can count on this cheap and effective package," says one of the Kappadu farmers, Narasa Reddy. "We observed that friendly birds only visit plots that were not sprayed with chemical or botanical insecticide, but they are intensely active on the plots sprayed with NPV where they feed on dead larvae that they can easily pick off the plants."

Bhagwat says ICRISAT will continue the on-farm research in the next season. More farmers need to be trained to prepare and use their own sprays as part of a user-friendly and environmentally benign technology.

(ICRISAT)



ICRISAT

ICARDA at 20

On Monday, June 2, the International Center for Agricultural Research in the Dry Areas, based in Aleppo, Syria, will celebrate its 20th anniversary: an occasion to proudly review the scientific achievements and services rendered to the countries of West Asia and North Africa, as well as to confront the challenge of rapidly rising food demand on top of a huge grain gap in an agricultural ecoregion characterized by environmental fragility and widespread rural poverty.

ICARDA's mission is to meet the challenge posed by a harsh, stressful, and variable environment in which the productivity of winter rainfed agricultural systems must be increased to higher sustainable levels; in which soil degradation must be arrested and possibly reversed, and in which the quality of the environment needs to be assured. ICARDA meets this challenge through research, training, and dissemination of information in partnership with the national agricultural research and development systems.

The Center has a world responsibility for the improvement of barley, lentil, and faba bean, and a regional responsibility in West Asia and North Africa for the improvement of wheat, chickpea, forage and pasture crops—with emphasis on rangeland improvement and small ruminant management and nutrition—and of the farming systems associated with them. The full scope of ICARDA's activities can be appreciated only when account is taken of the cooperative research carried out with many countries in West Asia and North Africa.

The results of research are transferred through cooperation with national and regional research institutions, with universities and ministries of agriculture, and through the technical assistance and training that the Center provides. A range of training programs is offered and these efforts are supported by seminars, publications, and specialized information services.

Better Trials

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"It's a line-source system," says John Peacock. "This is familiar to anyone who's ever seen water-use efficiency trials. Basically, you have the pipe that is the water source running at a right angle to your plots so that you create a gradient of water away from the source. The sirocco simulator will do the same with air." The machine is being calibrated with the help of data on wind speed and relative humidity for Morocco supplied by Hassan Ouabbou. The temperature data was collected by ICARDA agroclimatologist Wolfgang Goebel. The data being used stretches back over thirty years. The next step will be for John Peacock and Peter Eichhorn to thoroughly field-test the machine before the Mk II version is developed in North Africa.

The simulator should not only answer Peacock's questions about the actual physiological process of heat-stress at grain-filling. It should also speed up breeding trials. Droughts in the Maghreb are all too frequent, but they do not happen every year and it follows that testing for drought-resistance has hitherto been a longish process.

The simulator is also a piece of appropriate technology which national programs will be able to build for themselves. The second prototype had a notional cost of around 2,500 US-Dollars, but this was because an expensive type of boiler was used; it just happened to be available. A more normal heat source would be an ordinary domestic diesel-burning water-heater, of a type which is in common use all over the Maghreb and Mashreq regions. The motor for the fan came from an old high-pressure pump, the fan and radiator from a scrapped generator. As for the fuel, diesel is sometimes subsidized in the region; in Syria, for example, it is markedly cheaper than ordinary petroleum.

As head of ICARDA's workshop, Peter Eichhorn is well used to being asked for this sort of solution. He and his staff have helped develop appropriate technology for (for example) seed sweepers and pod-threshers, designed for use directly by farmers; some of this machinery has been put into production by an engineering company in Aleppo. "National programs are often short of funds," he says, "and this can be a constraint to research work. Machines like the simulator can greatly reduce this constraint. It's not a miracle solution; certain standards have to be observed, for example accuracy of temperature and consistency of wind-speed, and there will always be one or two components that can't come from the scrapyard. Even so, this is something national programs can put together for themselves.

(ICARDA)

Trees

Continued from page 1

Faso, guests will often find sheanut butter soap in their hotel rooms. This tree, difficult to propagate at the moment, is an important source of income throughout the Sahel and south into the savannas of northern Ghana and Nigeria.

A third tree, *Parkia biglobosa* (néré in francophone countries and dawadawa in anglophone areas), produces brown seeds that are ground into a pungent spice used in sauces throughout the region. This soumbala seasoning, sold as balls of brown paste, can easily be tracked down by its remarkable smell that is almost synonymous with Sahelian markets. The yellow powder in the pod is consumed raw or as porridge. Domestication of this tree is particularly urgent because the fruits are collected when they are still hanging and few seeds are able to germinate.

Other important trees include tamarind (*Tamarindus indica*), *Ziziphus mauritiana*, *Lannea microcarpa*, *Balanites aegyptica*, *Diospyros mespiliformis*, *Cordyla pinnata* and *Faidherbia albida*, all of which provide products and consumables for people and for livestock as well. These results, according to Elias Ayuk of ICRAF, show that farmers most prefer species that provide food security as well as a wide range of products.

In coming months, he reports, specialists from ICRAF and national agricultural research organizations will be assessing the value of the products of these trees on farms. This will lead to the actual tree improvement work in the area, and go a long way to point researchers in the right direction when they are working on agroforestry technologies suitable, and adoptable, in the Sahel.

(ICRAF)

In the next issue…

- Results of the Mid-Term Meeting
- Tef: An Underutilized Crop

Safety for the Seeds of the Future

By John Peacock and Mike Robbins

There are wildlife reserves where endangered animal species can live in the wild. So why not plant reservations? Now, through a wide partnership of countries and institutions in the Eastern Mediterranean, they are becoming a reality in four countries in West Asia. But with an important difference: these reservations will be working farms.

This biodiversity can be preserved in genebanks. ICARDA does this, as do a number of national programs and institutions within the region. In fact, ICARDA's genebank is one of the world's biggest, with 110,000 accessions so far, and distributes about 26,000 a year to scientists all over the world to use in crop breeding.

But this alone is not enough. We don't know how long we can store the material without it degenerating: moreover, while it is in a coldstore, it is not adapting to the changing world outside, which limits its usefulness in breeding. Just as important, genebanks cannot preserve more than a fraction of what we need to keep. *Ex-situ* conservation, as it is known, is important and has helped enormously, but we need *in-situ* conservation as well.

Conservation and Sustainable Use aims to do that, right in the environment to which we will need it to be adapted. That is part of the reason why scientists do not want to just create reservations for biodiversity; we need to use working farms, where the genetic material is tested by changes in farming practices and can be watched over by farmers who know what to look for. Anyway, simple reservations would dig too deep into scarce land resources. People must eat today, as well as tomorrow.

Conservation and Sustainable Use has been put together with Jordan, Syria, Lebanon and Palestine, and a number of important institutions. ICARDA will administer and coordinate the project, but will not spend the money; as the implementing bodies, the national programs will do that.

Total cost over five years will be roughly US$18.5 million, of which the crucial US$8 million core is expected to come from GEF, subject to remaining administrative and policy decisions. GEF is the Global Environment Facility, a financial mechanism providing grant and concessional funds to developing countries for projects and activities to protect the world's environment. By the end of 1991, the framework for action for the GEF gained the support of a sufficient number of countries to become a reality. At the Rio Earth Summit in 1992, it was decided that GEF would operate the financial mechanisms for implementation of the Conventions on Climate Change and Biological Diversity. Today, responsibility for implementing the GEF is shared by UNDP, UNEP and the World Bank. Projects thus funded fall under four basic areas; climate change, biological diversity, international waters and ozone depletion.

GEF's contribution is the key to making the Conservation and Sustainable Use project fly; other generous contributions in cash and kind have been pledged on this basis.

Besides in-situ conservation at the eight sites, the project's objectives are to:

- Gather information on the genetic base of 10 target crops and the social and farming practices which affect them:
- Produce a working model for in-situ, on-farm conservation that can be repeated elsewhere in the world;
- Devise a broad range of policy measures that can safeguard and enable such world;
- Strengthen national capacities for the sustainable conservation of agrobiodiversity.

None of this will be simple. For example, producing the database means using Geographic Information Systems (GIS). The scientists will have some help: one of the participating institutions is the International Plant Genetic Resources Institute (IPGRI), which is based in Rome but has its regional office on the ICARDA campus. It already holds some data for the area. But there will be a need to train national scientists in the use of GIS, so that training will be part of the project.

If the project is to gather information on the way the genetic material is affected by changing social and landuse practices, it will need to be monitored. This will be done through a network of extension officers. Farmers can also help—they know what to look for. Other assistance will also be needed from farmers. One of the key parts of the project is to persuade them to (say) keep sheep away from wild relatives of forage legumes at the flowering stage, let a wild variety of crop wild relatives grow at the margins of their fields, and grow a good mix of landraces (farmerbred crop varieties) in the fields themselves. In the main, farmers do not need to be persuaded of the importance of biodiversity. But—again—people must eat today, as well as tomorrow. So there will have to be compensation in cash and kind for farmers who are asked to change their farming patterns.

ICARDA genebank.

Meanwhile, on the ground, landuse survey will be done of the target sites and

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Groundwater

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than small farmers. Policies to assist poor farmers with credit to purchase tubewells would be beneficial, especially policies that encourage farmers to join together to purchase, install, and operate tubewells as shared enterprises. Farmers, whether they are building a private well or sharing in a jointly owned one, would benefit from technical assistance in locating pockets of fresh water, the report concludes.

The report indicates that owning a tubewell contributes more to increased productivity than purchasing water, largely because purchased water is not reliable: farmers cannot count on being able to purchase adequate supplies of water at just the time they need it. Farmers who owned their own tubewells had gross margins of Rs. 5,000, more than twice as high as farmers who only purchased water; farmers who had access to both canal water and their own tubewells had gross margins of Rs. 18,000.

At present, farmers must sell groundwater to those who live nearby because the cost of pumping it long distances is prohibitive. Where possible, farmers should be permitted to run water through canal courses as long as they do not interfere with canal operations. Although private tubewells increase farmers' control over water and hence increase productivity, they are a viable option only in areas where good quality water is abundant. In Punjab as a whole, 25 percent more groundwater is already being pumped out of the ground than is being recharged. Where good groundwater is limited, efforts to share water supplies equitably through development of water markets and joint ownership of wells must take high priority.

(IFPRI)

NEWS

Cassava Boom in Southeast Asia

Improved high-starch varieties are boosting Southeast Asia's cassava output while diversification of marketing helps stabilize prices. In Thailand, Indonesia, and Vietnam, the improved cassava varieties developed by CIAT in collaboration with national researchers have already spread to more than 500,000 hectares. According to CIAT's preliminary but conservative estimates, the new varieties have created benefits of nearly a half billion dollars over the last seven years, mostly for small farmers. At the same time, employment in cassava processing has risen rapidly.

The humble root crop covers 3.9 million hectares in Asia, more than in Latin America, where cassava originated. Because the crop is highly tolerant of drought and infertile soils, it is planted mostly by Southeast Asia's poorest farmers living in marginal uplands, above the more productive lowlands occupied by wet rice.

"We've found that improved varieties of cassava, developed from crosses between local and Latin American germplasm, increase farmers' crop yields by 20 to 40 percent, says Kazuo Kawano, a CIAT cassava breeder. "The roots of the new varieties also have much higher starch contents. Greater starch yields from the same amount of land translate into higher income for farmers who sell cassava to starch processors."

The new varieties resulted from Kawano's longstanding collaboration with national research institutes in a half dozen Asian countries. The Japanese government supported CIAT's cassava research in Asia for more than a decade.

"In just two years, improved varieties developed in Thailand have spread to nearly ten percent of Vietnam's total cassava area of 283,000 hectares, according to Hoang Kim," director of the Hung Loc Agricultural Research Center in Dong Nai province. "Farmers are especially enthusiastic about the varieties in southern Vietnam, where most of our starch processing takes place."

Starch processing in Vietnam is performed both in rural households with traditional methods and by large, modern factories. Most of the starch goes to domestic food processing, mainly into the production of monosodium glutamate, an important flavoring agent, while some is used in the production of textiles, paper, and other products.

Until recently, the Vietnamese considered cassava a crop of last resort. "It has helped Vietnam through at least two major famines since World War II and was a staple of the Vietnamese army during the wars with France and the USA," says Thai Phien of Vietnam's National Institute for Soils and Fertilizers. But now the crop is acquiring a new image as a raw material for industry.

Thailand was the first country to exploit the industrial prospects of cassava on a large scale. Since the 1970s it has exported enormous quantities of dried cassava chips and pellets to the countries of the European Union, which use them in animal feed. More recently, the private sector in Thailand has created new cassava markets by exploiting the crop's potential as a source of cheap starch. According to reports from Kasetsart University in Bangkok, about 50 percent of the country's cassava now goes to starch production. About a third of this is further processed into various modified starches, and half of the total starch production is exported to Taiwan and Japan.

With the benefits of the new varieties have come risks. "In 1995, cassava prices were quite high in Thailand and Vietnam, prompting farmers to expand the area planted," says CIAT agronomist Reinhardt Howeler. "Then, in 1996, prices dropped considerably because of overproduction and declining starch prices in the world market. In Thailand, some growers lobbied successfully for cassava price subsidies."

However, the private sector's continuing efforts to further diversify cassava products and markets are likely to lessen the risks for small scale producers throughout Southeast Asia: "Competing de-

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Cassava Boom

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mands for cassava roots should enable growers to obtain better prices," said Howeler. "Continued adoption of improved varieties will further increase their returns from the same amount of land."

To balance its cassava production with industrial demand, Thailand embarked in 1993 on a program to reduce the cassava area by 20 percent and intensify production on the remaining area through massive dissemination of improved varieties. "By 1996, the new varieties had spread to about 384,000 hectares or nearly a third of the country's total cassava area," explains Wilawan Vongkasem of Thailand's Department of Agricultural Extension.

A potential downside of the cassava boom is the fragility of upland soils on which the crop is grown. To meet rising demand, farmers will inevitably intensify production, raising the specter of serious soil erosion, warned Howeler. With a grant from Japan's Nippon Foundation, he is working closely with national institutes and farmers to find ways of making the cassava boom environmentally sustainable.

(CIAT)

Bangladesh: Rice

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rate decreased to 2 percent in recent decades, it is not expected to stabilize within the next 25-30 years. This problem is not confined to Bangladesh. In Asia, total annual rice production must increase by 60 percent over the same period, just to maintain adequate levels of supply – and this has to be achieved on less land, with less water, fewer rural workers, and with fewer environment-harming chemicals.

Meeting the challenge of increasing rice production will become increasingly difficult in Bangladesh as rice areas will continuously shrink to meet the growing demand for high-value crops and for urban and industrial development. Increasing irrigation coverage to the fullest ecologically sustainable level would form a major cornerstone of a strategy for higher rice production. Also needed are higher yielding varieties with different maturity periods and plant height combinations that are suitable not only for flood-free areas but also for shallow-flooded ricelands.

Because of the limited availability of irrigation, rainfed lowlands will remain important for rice production. Ways of improving and stabilizing rice yields through varietal development and resource management will be needed for the rainfed lowlands.

The one-million hectares of coastal ricelands, with varying degrees of salinity, offer an opportunity for future exploitation. Use of new biotechnology tools and products, and adoption of hybrid rice technology, will be needed in the future to raise and maintain yields in the irrigated ecosystem. An overall economic environment that provides economic incentives to farmers for higher rice production should be maintained. At the same time, production costs will have to be reduced to make rice cultivation in Bangladesh internationally competitive.

In February, IRRI — in collaboration with BRRI — held a symposium on "Partnership in rice research for sustainable agricultural development in Bangladesh." The symposium discussed major issues and challenges that Bangladesh will face in the early 21st century for achieving and sustaining food security, and the role that rice research could play in meeting those challenges.

(IRRI)

Making Muri…

Joygun Nessa's life in Tangail, Bangladesh, revolves around rice: she eats it; her family produces it on their farm; and it supplies her with a livelihood: making muri, puffed rice.

Rice and salt and sand—as a medium for puffing the rice—is all she needs. Ms. Nessa, however, does not use just any rice. She recommends IR8 developed by IRRI, or BR11 for the best results.

To prepare her specialty, she uses a clay stove in which the fire is underground. It uses one-third less fuel than other stoves, which is important in a country suffering from fuel shortage. She has been using the stove for about 7 years.

Squatting by the stove, she stokes the fire by throwing fistfuls of wheat straw down the stove's holes. Sometimes she uses balls of cow dung, rice hull, and sticks for fuel. The heat produced is intense.

Over one of the holes, she heats up a large clay pot with sand in it. Rice in salted water is warmed in a small pot over a different hole. She stirs the rice with a naruni, a utensil made of palm-midribs bunched together.

When the right temperature is reached, she skillfully pours the rice into the big pot with the sand and swirls it for 30 seconds. Suddenly, the rice becomes alive in a burst of steam and fills the pot.

Ms. Nessa knows exactly when the rice is done puffing. If she hesitates a moment too long, the rice will burn. With the precision of a master chef, she dumps the contents into a clay strainer and shakes out the sand.

The muri is warm and mildly salty, with a nutty taste. She makes it every day so that it's fresh for her customers and family.

She markets the muri in bulk and in small plastic bags at the family's grocery store. From 40 kilograms of rough rice, she gets about 26 kilograms of muri. For every kilogram of muri sold, she earns 20 taka. Ms Nessa usually sells 52 kilograms of the snack food each week, earning about 1,400 taka. Her yearly income from this business is 72,800 taka.

If she would simply sell the rough rice in the market, she would get 12 taka per kilogram. Selling the 80 kilograms of rough rice used to make muri, she would only earn 960 taka—440 taka less.

"Muri is profitable!" she says with a smile.

(IRRI)

CGIAR Financial Concepts and Terminology

The Research Agenda. The research agenda comprises the bulk of CGIAR center projects and activities. Components may be executed by one or more centers and/or jointly with national agricultural research systems, advanced research institutions, and non-governmental organizations. Centers develop the agenda and work programs in collaboration with partners. The CGIAR's Technical Advisory Committee reviews the agenda and, if appropriate, recommends it for CGIAR financing. Projects included in the agenda must meet four criteria. They must:

- be aimed at producing research or research-related (including training) international public goods;
- be of high priority in terms of accomplishing the CGIAR's goals and objectives;
- have acceptable probabilities of success; and
- not have alternative producers or sources of supply with suitable costs or reliability.

Non-agenda comprises activities which a center is qualified to undertake because of experience, location, size, or other factors, but which do not meet all of the criteria for inclusion in the research agenda.

Financing the Agenda. The agenda, as endorsed by the Group, is eligible for financing by members, including the World Bank. The financial requirements approved are the minimum needed to implement the agenda. All centers and partners are encouraged to maximize financing, and there is no disincentive to do so. Mechanisms to ensure that the agenda is fully funded have evolved from earlier unsuccessful attempts to "guarantee" full financing solely using World Bank funds. Recently, changes have been made in the financing arrangements whereby members, instead of the World Bank alone, act to collectively fill any financial gaps that might arise in the course of the year. Most members now channel all of their support to the agenda.

Financing Modalities. Centers are primarily financed by annual support from CGIAR members. A modest amount is also available from annual miscellaneous income of the centers. This includes contributions from *ad hoc* sources who are not CGIAR members. The nature of financing does not influence or determine whether a project is part of the agenda. Member financing may be directed to the CGIAR, centers, programs, and projects with different degrees of specificity:

- to the CGIAR with flexibility regarding allocation based on CGIAR priorities;
- to centers or programs without any restrictions (with or without attribution requirements); or
- targeted to a specific center project, or subproject, or activity as defined in a contractual agreement.

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The CGIAR's Annual Financial Decisionmaking Process and Schedule (effective 1997)

Setting the Agenda (MTM - May). At the Mid-Term Meeting, the CGIAR Technical Advisory Committee proposes the research agenda for the following year based on interactions with the centers. Center proposals are based on the research directions agreed upon during a triennial consideration of center medium-term plans (effective 1998). The Group debates TAC's recommendations, taking into consideration advice from the Finance Committee on funding prospects, and endorses the proposed research agenda and financial allocations, with or without modification. Following the Mid-Term Meeting, the centers and the CGIAR Secretariat solicit overall financing indications from members.

Preparation of Financing Plans (June - September). Centers prepare their individual financing plans for the following year based on specific financing information solicited through bilateral contacts with members and past trends. World Bank funding is included on a percentage basis of funding secured by centers from other members—9 percent in 1997 and 12 percent in 1998.

Confirmation of Program Content (mid-September). Centers indicate to TAC and the CGIAR Secretariat any changes in expected funding for the research agenda, as determined through center interactions with individual members, and the implications of these changes on program content. TAC reviews the program content of the research agenda and highlights any significant changes for action by the Group at International Centers Week.

Review of Financing Plans (end-September - October). Following the confirmation of program content by TAC, the Finance Committee reviews center financing plans, including the contribution of the World Bank, for consistency and feasibility, based on funding information solicited by the CGIAR Secretariat.

Approval of the Research Agenda and Financing Plan (ICW - October). At International Centers Week, the Group considers the finalized research agenda and financing plan for the following year, leading to approval of financing and implementation of the research agenda.

Disbursement and Implementation (January - December). Following approval by the Group at international Centers Week (in the previous year) of the research agenda and financing plan, centers commence implementation of the agenda on January 1 of the current year, and members disburse funds to the centers. Of the World Bank funds, half are distributed in January; the remaining half are disbursed in June, following a review of updated center financing plans by the Finance Committee at the Mid-Term Meeting.

Accountability (Year End). At the end of the current year, centers prepare financial statements showing the use of the funds received in support of the research agenda. As well, centers confirm the use of the funds provided by the World Bank and refund any overcommitted funds to the Bank.

CGIAR Financial Concepts

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All members are expected to contribute to the full cost of center operations, including a proportionate share of administrative costs. The World Bank financing is always made available as general CGIAR support. All members are encouraged to provide their support in a similar manner. Members usually disburse funds based on their financial procedures, directly to centers throughout the year. The CGIAR Secretariat provides disbursement services, through the World Bank, to members who prefer to make a single disbursement to the CGIAR.

CGIAR Agenda Matrix. The distribution of financial resources is presented as the CGIAR research agenda matrix, with centers comprising the rows and CGIAR activities the columns. Activities, presently nineteen in number, are aggregated into five groups, representing the principal undertakings of the CGIAR. The matrix is constructed by fully allocating costs of center projects to the CGIAR activities. [Projects are the basic center unit of activity with objectives, outcomes, and milestones. A CGIAR project portfolio of about 300 projects, with common definitions and concepts used by all centers, is in effect in 1997.] The CGIAR has identified several thematic areas as systemwide programs to respond to specific challenges and to strengthen collaboration among centers and with partners. Center participation in these, included in the agenda matrix, is also presented in a supplementary matrix.

Implementation. Centers often implement the agenda in partnership with advanced institutions, NGOs, and NARS. These joint ventures may involve shared tasks at different points on the research continuum, from upstream laboratory-based research to applied field-level experimentation. Funding of such joint ventures is included in financing for the CGIAR research agenda.

NEWS

Women Dairy Farmers in Africa

Women provide 46 percent of Africa's agricultural labor, produce about 70 percent of its food, perform almost 60 percent of the marketing and do at least half of the tasks involved in storing food and raising animals. Alarmingly, however, only 20 percent of these women are the direct recipients of extension advice. Studies by ILRI and the Kenya Agricultural Research Institute (KARI) have investigated what effects a smallholder dairying package had on women's workloads and what implications this would have for dairy development.

The study showed that, while 84 percent of the farms included in the study were owned by men, 84 percent of the dairy operators were women. On the farms where extension messages were delivered to men, three-quarters of the dairy operators were women.

Across all the farms, 48 percent of the people interviewed said that women did all or most of the dairy work, 25 percent said that hired laborers did most of the work and 22 percent indicated it was children who provided most of the labor. Only 5% said that husbands did most of the work in the dairy unit. But on the farms where men received the extension advice, over half of the husbands had exclusive control over the income generated by the dairy enterprise and in another 27 percent of the cases they shared control, despite the fact that three-quarters of the dairy operators were female. Extension officers reported that some female dairy operators lacked enthusiasm and conscientiousness in following extension advice because they derived little personal financial reward from their efforts in the dairy enterprise.

ILRI

However, almost all (97%) of the people interviewed said that their total household income had increased since they adopted the Kenya National Dairy Development Project package and nine out of ten said that they had more milk for home consumption. The women felt that the benefits to the household outweighed their lack of reward. The most common use of the additional dairy income was food for the household (72%), followed by school fees (34%), dairy inputs (34%), hired labor (22%), school books (16%) and clothing (9%).

Any strategy for increasing dairy production in subhumid East Africa must take into account that many, if not most, smallholder units are managed by women and that these women must be involved in defining the research agenda to make sure their needs are taken into account.

(ILRI)

Safety for Seeds

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"buffer strips" introduced. Stone-clearing for land exploitation often destroys the wild relatives' habitat, but is necessary for income generation, so the project will get these cleared stones used to make new, similar habitats. Small simple dams and terraces will be built to provide niches for alternative income generation and diversified plant production. Where there is no alternative to discouraging agricultural activity in a given area, the project will go for imaginative solutions such as apiculture. (This can work well, and ICARDA's Highland Regional Project has helped encourage beekeeping in the Taurus Mountains in Turkey with some success.) Field gene banks will be established for vulnerable species in field margins.

There is much more to this project, and the activities above are only a sample; it is impossible to describe them all. Conservation and Sustainable Use of Dryland Biodiversity is one of the most exciting projects with which ICARDA has become involved, not least for the unanimity that has been achieved across nations, institutions and disciplines in putting it together. But perhaps its most important feature is this: what we learn in Lebanon, Jordan, Syria and Palestine over the next five years could provide a model for sustainable in-situ conservation of agrobiodiversity around the world.

(ICARDA)

The CGIAR

CGIAR Chairman
Ismail Serageldin

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