ILEIA NEWSLETTER

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FOR LOW EXTERNAL INPUT AND SUSTAINABLE AGRICULTURE

LOCAL VARIETIES ARE OUR SOURCE OF HEALTH AND STRENGTH

Women use local knowledge to ensure survival

Amazonian myth gives peasants' views

Farmers welcome iguanas in forests of Panama

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Dear Readers,

Local varieties are our source of health and strength!

This quote from a Himalayan woman farmer fortunately still holds true for many Third World farmers. They still rely upon their own indigenous varieties of seeds, wild plants, trees and animals for their food. They are continually adapting, experimenting, exchanging and breeding these varieties for multiple purposes: taste, colour, size, yield, straw quantity, site specifity, to mention but a few. Linked to these local varieties is the farmers' knowledge about how to manage and improve them. Concern about the threatening loss of genetic diversity of crop plants and animal species and their wild relatives is based on negative experiences of the Green Revolution. With the disappearance of indigenous varieties also the knowledge about their use will be lost.

Genetic diversity is necessary for sustainable agriculture to keep future agricultural options open. Farmers need genetic diversity to be able to adjust their crops to altered circumstances: pests and diseases evolve new strains and overcome resistance, soil conditions change, climates alter.

No doubt, the ''seeds issue'' is a political issue. We are not trying to by-pass this aspect, but we have concentrated here on practical experiences with the introduction of high-yielding varieties and possible alternatives. But is biotechnological research preparing us for a new miracle ''to end hunger'' with, e.g. nitrogen-fixing grains in the desert? The main question will remain: Will farmers be able in the future to maintain and increase diversity on their farms, keeping access to their indigenous varieties and improving them to meet future food demands?

The Editors

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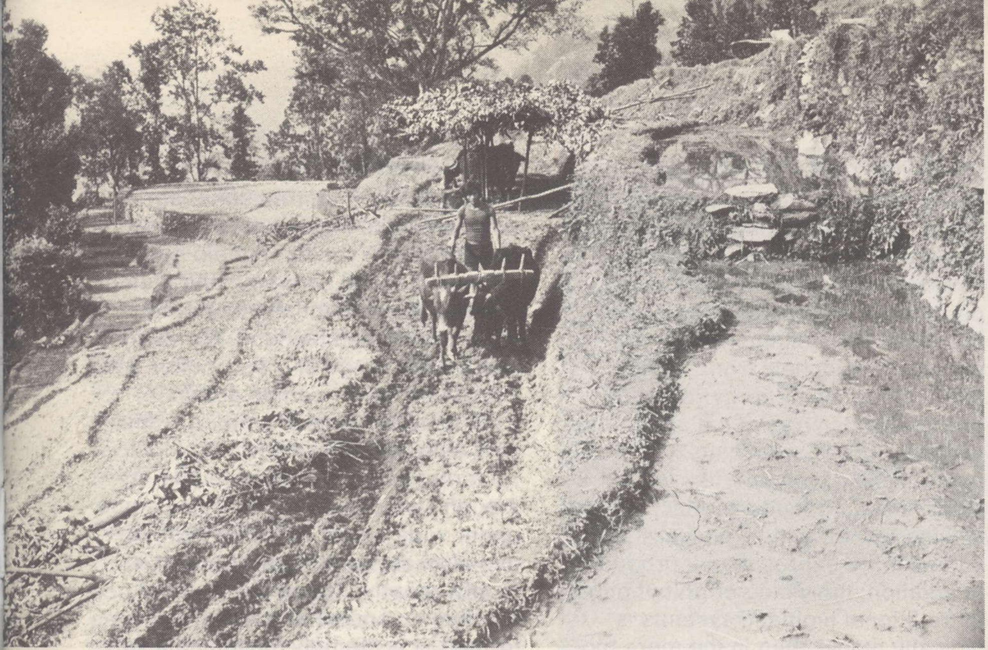
Cover photo: Spring in Dandapakhar, Nepal. Women carry home the grains they have harvested. In many parts of the world, women still possess valuable knowledge about indigenous and locally developed varieties of food crops. (Photo: Fritz Berger)



The shifting cultivators in eastern Nepal have tiny fields scattered over a thousand meters in elevation. (Photo: Purna Chhetri)

NEPAL/INDONESIA

Conserving genetic resources at the farm level

Conservationists and ecologists are often blamed for being 'conservative', focussing too much on preservation. Critics say: 'they want to turn nature into parks and keep farmers out'. In this article Jeffrey McNeely argues that sustainable farming makes an important contribution to conserving nature and that the people who live around protected areas benefit from them. Future food demands have to be met by increasing agricultural productivity. This should be based on the wisdom inherent in many traditional practices.

Jeffrey McNeely

When I was in eastern Nepal in 1972-1974, I knew Bim Bahadur, a farmer who grew 20 varieties of rice. Although he was illiterate, he knew exactly which variety he was going to plan where, and why; he had a full understanding of variables such as slope, aspect, pests, rainfall, and temperature. He carefully explained that since his tiny fields were scattered over a thousand meters in elevation, he needed the variety to ensure that he was able to harvest enough rice to feed his family, no matter what happened. He knew that the monsoon winds could be late, or early. He knew that he would lose some rice to monkeys, and to wild pigs; he hoped to snare the latter, but the former were semi-sacred and thus not hunted, though his sons felt perfectly free to pelt them with stones. He knew that his irrigation system would break down several times during the rainy season, requiring repairs to both canals and fields. He knew that weeds would also flourish in his fields, and that his wife and daughters would need to share their time among weeding, cooking, and gathering firewood.

Surplus

If Bim Bahadur were able to produce a surplus, as he hoped (and as he did during the two years I spent in his valley), then he would give some to his relatives, loan some to other farmers who might be able to help him in return some day, sell some to those who could pay, and donate some to the local temple. In addition, he planted a range of other crops including maize, potatoes, oranges, and flowers. He and his family gathered wild fruits, vegetables and medicinal plants from the oak forest above the village, and sent their livestock into the high mountain pastures for grazing in the shadow of Mt. Makalu. His annual cash income was certainly less than US$ 50. He was a young grandfather, but looked old. His wife was younger, but looked older. Development agencies would consider him one of the ''poorest of the poor'', and therefore a target for development.

Another 'development target'

Several years later, when I was working in Indonesia, I spent some time on Siberut, an island of 440,000 hectares 100 km off the west coast of Sumatra. The 18,000 people living on Siberut divided their island into 15 units, each with its own language and each tending to occupy one or more river drainages. Their economy was based on sago and taro as principal crops, with fish, pigs, and monkeys (three species of which are endemic to Siberut and surrounding islands) providing most of the protein. Each day invested by the people in harvesting the sago palms which grew wild in the low-lying swamps would supply sufficient staple food for over 17 days. They supplemented sago with a simple form of dibble-stick agriculture which requires that only small patches of forest (0.25 – 0.5 ha) are cleared, but not burned. Because of the shielding properties of the cut debris, the surface humus and soil are not leached of their nutrients, which are used by the freshly-planted crops of taro, cassava, and bananas.
New nutrients are released slowly from the debris to the soil because the different components (leaves, twigs, wood) degrade at different rates. These nutrients are utilized by fruit trees and spice trees which are planted while the first crop is maturing. By the time the covering of debris has lost its protective properties, the surface soil is held together by a mat of grasses, shrubs, and fairly low trees. Old traditional swiddens gradually become groves of mature fruit trees, which can take on a forest-like structure, with large durian and jack-fruit trees interspersed with lemons, jambu, langsat, papaya, and guava (McNeely et al., 1980).
Few of the people were literate, or even spoke Indonesian. Much of the swampy land could grow rice, and the forests were a potentially rich source of timber revenue. Siberut, too, was a target for development.

Shifting Cultivation and Biological Diversity: Some Examples

Among the Lua (Lawa) of northern Thailand, about 120 crops are grown, including 75 food crops, 21 medicinal crops, 20 plants for ceremonial or decorative purposes, and 7 for weaving or dyes; the fallow swiddens continue to be productive for grazing or collecting, with well over 300 species utilized (Kunstadter, 1970). The most important crop is upland rice, and it is not unusual that 20 varieties of seed rice are kept in a village, each with different characteristics and planted according to soil, fertility, and humidity of the fields. The Hanunoo of the Philippines may plant 150 species of crops at one time or another in the same swidden. At the sides and against the swidden fences grow low, climbing or sprawling legumes (asparagus beans, sieva beans, hyacinth beans, string beans, and cowpeas). Toward the centre of the swidden, ripening grain crops dominate, but also numerous maturing root crops, shrub legumes and tree crops are found. Pole-climbing yam vines, heart-shaped taro leaves, ground-hugging sweet potato vines, and shrublike manioc stems are the only visible signs of the large store of starch staples which is building up underground, while the grain crops flourish a meter or so above the swidden floor before giving way to the more widely spaced and less rapidly-maturing tree crops. A new swidden produces a steady stream of harvestable food in the form of seed grains, pulses, sturdy tubers, bananas, spices, and many others (Conklin, 1954).
Among the Tsembaga Mareng of Papua New Guinea, each field contains some 15 to 10 major crops, plus dozens of minor crops, spread seemingly at random through the field. "This intermingling does more than make the best use of a fixed volume," says Rappaport (1971). "It also discourages plant-specific insect pests, it allows advantage to be taken of slight variations in garden habitats, it is protective of the thin tropical soil and it achieves a high photosynthetic efficiency."

Development and diversity

Many of the "targets for development" are in fact already doing reasonably well, all things considered. They are well adapted to producing predictable minimum yields under unpredictable conditions, with no expectations of help from outside their community. Energy return for energy input in traditional agriculture is quite high, approaching 20:1 (Rappaport, 1972); compare this with industrialized agriculture, which – from sowing to marketing – typically consumes more energy than it produces. In addition, the yield per unit of effort in traditional highland systems is typically higher than in the more modern lowland systems, giving the upland farmer more time for hunting, social interactions, and ceremonial activities.
Some of these farmers own their own land, and – like my friend in Nepal – have made substantial investments in their own irrigation systems.
Others – like the people of Siberut – do not enjoy government-approved ownership, but exercise long-term traditional use rights to the areas over which they harvest wild produce and rotate their fields.

Reduced genetic diversity

Whatever the situation of the farmers, modern forms of development typically involve reducing the genetic diversity of the crops they grow, both within a crop (growing fewer varieties of high-yielding rice, for example) and between crops (growing fewer crop, but taking advantage of, for example, improved access to markets). In the case of Siberut, the government determined that growing rice was superior to sago, even though it required more labour per calorie produced; and getting people out of the forests meant fewer conflicts over the logging rights that had been sold to concessionaires.
The narrowing genetic base can have serious consequences for those adopting the new varieties. For example, Indonesia lost over two million tons of its rice crop in 1977 when the widely planted IR36 variety – introduced to combat the brown plant hopper – proved susceptible to tungro virus. IR36 still occupied over half of Java's lowland paddy area in 1980.
While development may well provide schools, improved medical care, and access to the benefits of modern society, it also can deplete the genetic resources which all societies require to adapt to changing conditions.

Shifting cultivation and diversity

On the other hand, traditional agriculture can make important contributions to agricultural research, help conserve biological diversity, and maintain healthy relationships between rural people and the land. For example, a wide range of crops – often over 100 at one time – can be grown in traditional systems of shifting cultivation, essentially transforming a natural forest into a harvestable one. Although swidden agriculture has come under wide abuse as being destructive of forests and watersheds, it is highly adaptive to a wide range of conditions, and when properly performed, it is the only sustainable way of cultivating areas where poor soils, steep gradients, and heavy rainfall make conventional farming methods unproductive or impossible. As practiced by stable groups, swidden agriculture is not particularly destructive of forest, land, or wildlife. Permanent villages are established, moving only if forced to do so by extremes of economic hardship, political disturbance, or population pressure, not as a logical consequence of their agricultural techniques (Hinton, 1970).

Fertility maintenance

Sedentary swidden agriculturalists have a strong interest in maintaining the fertility of the village territory and practice a number of long-term conservation measures which contribute to biological diversity, including:

- preservation of stands of timber in and around the swidden to serve as a seed reservoir for new secondary forest;
- sophisticated control of fire (including fire breaks, fire-fighters, and coordinated burning);
- early cutting of forest to retain soil moisture, reducing transpiration losses so that swidden soil is often more moist than adjacent forest soil;
- careful rotation of swiddens, using each one for only one year;
- a bush-fallowing period of at least 10 years to allow the flow of nutrients to reverse the trend toward leaching and be recycled through burning;
- careful control of weeds;
- minimal disturbance of topsoil, thus minimizing erosion.

Because shifting cultivation in the traditional manner is highly diversified, it is more stable and reliable for the farmer than specialized cultivation. Economic self-sufficiency protects ecological integrity and viability in ways more important than simply maintaining diversity. Since traditional swidden farmers are concerned

primarily with their biological needs and those of the species sustaining them, they are not worried about external forces such as commodity prices, energy supplies, and environmental abuse.
It is clear to all farmers living in such systems, says Rappaport (1972), "that their survival is contingent upon the maintenance, rather than the mere exploitation, of the larger community of which they know themselves to be only parts".

Valuable wild plants

The wild relatives of a variety of important crop plants occur in the forests of SE Asia and these and the primitive cultivars grown by the swidden cultivators are valuable sources of genetic material for modern plant breeders. Rice, for example, provides the main staple for all of Asia, and the traditional rice varieties grown in upland swiddens contain great genetic diversity; the swidden farmers have often cross-bred domestic rice with its wild relatives, bringing new pest-resistance to their crops (Oka and Chang, 1961).
The species grown in the swiddens are in a state of continuous adaptation to the environment and, in many places, the crops are enriched by gene exchange with wild or weedy relatives. Altieri and Merrick (1987) contend that "maintenance of traditional agroecosystems is the only sensible strategy to preserve *in situ* repositories of crop germplasm." Further, the management of traditional systems will be maintained only when guided by the local intimate knowledge of the plants and their requirements, and what local management practices are likely to be most productive. In short, traditional shifting cultivation is a system which is well adapted to the tropical forest environment, helps maintain the biological diversity of the forest and the genetic diversity of the crops grown, and often provides significant benefits to wildlife populations. The maintenance of such systems is therefore of considerable relevance to modern forms of development.

The last village before the forest begins in eastern Nepal. The villagers practise both shifting cultivation and permanent dryland cultivation. (Photo: Jeffrey McNeely)

In Indonesia, the shifting cultivation mimics the forest and turns much of its productivity to human benefit. (Photo: Jeffrey McNeely)

Local knowledge for conservation

The challenge is to find ways of enabling traditional agricultural systems – such as shifting cultivation – to contribute to evolving relationships between people and their living resources. Traditional agriculture has adapted to a wide variety of local environments, producing diversity and reliability of food supply, reducing incidence of disease and insect problems, using labour efficiently, intensifying production with limited resources, and earning maximum returns under low levels of technology. It utilizes a very wide variety of species and landraces which vary in their reaction to diseases and insect pests, and to different conditions of soil, rainfall, and sunlight. It provides sustainable yields by drawing on centuries of accumulated experience by farmers who did not depend on scientific information, external inputs, capita, credit, or markets.

Higher productivity

But with growing population, steps need to be taken to enhance the productivity of lands under traditional agriculture. In the uplands, modern agricultural development should take existing swidden systems as starting points and use modern agricultural science to improve on the productivity

Wild cattle and shifting cultivation

Southeast Asia is the home of the wild cattle which are the closest relatives to domestic cattle, and therefore of particular importance for stock-breeders. Three main species are involved: Gaur (*Bos gaurus*), ranging from India and Nepal to peninsular Malaysia; the Banteng (*Bos javanicus*), ranging from Burma to Borneo, Java, and Bali, but not found in Sumatra or most of peninsular Malaysia; and the Douprey (*Bos sauveli*), the rarest and most recently-discovered species (first described in 1937), found only in Indochina.

Charles Wharton (1968) found that each species has a close ecological relationship with shifting cultivation. The gaur prefers foothill tracts of sub-humid or deciduous forest adjacent to savanna forest, glades or other open terrain affected by man and fire; the gaur has followed shifting cultivation into peninsular Malaysia. The banteng is confined to savanna forests within the drier deciduous forest zones of the region; in the more humid areas, they occupy the secondary serial stages following the alteration of the original forest by man and fire. The best habitats for kouprey are found where abandoned ricefields were left by the ancient Khmer civilization whose capital was Angkor Wat; these old ricefields are still burned annually by rural Khmer farmers, thus maintaining a savanna habitat which appeals to the kouprey and other wild cattle. Wharton concludes that since fire so materially aids hunting and gathering in the savanna forest areas such as northern Cambodia, it was probably equally useful during prehistoric times. It would thus appear that the savanna forests of southeast Asia may be ancient indeed, having been created by human-caused fires and occupied by wild cattle and other large herbivores. The living wild cattle of southeast Asia appear intimately dependent on an environment which is, if not entirely created by man and fire, certainly maintained by these agencies. They have survived due to "a fortuitous combination of human activity and monsoon climate acting upon characteristic terrain and bedrock."

of the system. Development should be based on the ability of swidden farmers to adapt to change, but would continue to draw on resource-conserving and yield-sustaining production technologies (Altieri and Merrick, 1987).
The essential element is the design of self-sustaining agroecosystems which assure the maintenance of local genetic diversity available to farmers, thereby enabling rural communities of swidden cultivators to maintain control over their production systems.
In addition, the ability to maintain a stable and permanent relationship with forested land enables some swidden farmers to invest time and effort in other permanent assets like fruit trees, fenced gardens, terraces, and irrigation canals. In the most suitable areas, the swiddens are supplemented by irrigated ricefields, thus allowing a considerably higher population density than under swidden conditions alone. Such mixed systems will often enable modern agricultural techniques to be wedded to the traditional ones, and lead to the establishment of more permanent villages.

Research to benefit the poor

Large areas of forest which are protected against outside encroachment and assigned to specific ethnic groups for sustainable management might be a means of ensuring the productivity of shifting cultivation systems, coupled with a research effort aimed at ensuring a steady delivery of contributions to agricultural development. In some places, community-level "landrace custodians" could be given subsidies, if necessary, to maintain their traditional agricultural systems which enable the continuing evolution of genetic diversity important to agricultural development.
Research aimed at benefitting the poorest farmers should be based on the ecological approach and on existing traditional agriculture. This might include the development of more efficient low-input agricultural systems based on biological recycling of energy and chemical nutrients, and relying primarily on naturally occurring control mechanisms for crop protection. It should seek to develop new agricultural systems, often building on rediscovered or newly-appreciated traditional systems. A wide spectrum of agricultural crops should be considered, including many which might be viewed as "non-traditional". Restoring, maintaining, and improving the natural resource base should be the basis for offering farmers a reasonable chance for economic betterment.

Wisdom

Agricultural ecologists have learned to respect the wisdom inherent in much traditional practice. Involving the ultimate clients of agricultural research in both the design and testing of improved technology will allow specialists to capture some of the practical knowledge about agroecosystems, and offer greater assurance that new methods will be more widely adopted once their effectiveness has been demonstrated. Within its limits, traditional farming can continue to make a meaningful input into the total agricultural productivity of the regional and contribute to the biological diversity of the tropical forest ecosystem, if it is developed as part of the overall system of conservation-oriented management. ■

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Women ensure survival

To improve the agricultural situation in Africa, there is a tendency to look to the "success" of India's Green Revolution. But the failures are now apparent, as Vandana Shiva points out. What can be learned from women? Monika Hoffmann reports on a travelling workshop as a new way to exchange indigenous knowledge among women. Are there other ways?

Peasant women know the nutritional needs of their families and the nutritive content of the crops they grown. Among food crops they prefer those with maximum nutrition to those with a value for the market. (Photo: Fritz Berger)

The myth of the miracle seeds

Vandana Shiva

Seeds are the first link in the food chain. For 5000 years, peasants have produced their own seeds, selecting, storing and replanting, and letting nature take its course in the food chain. The feminine principle has been conserved through the conservation of seeds by women in their work in food and grain storage. With the preservation of genetic diversity and the self-renewability of food crops has been associated the control by women and Third World peasants over germplasm, the source of all plant wealth. All this changed with the Green Revolution, which commercialized and privatized seeds, removing control of plant genetic resources from Third World peasant women and giving it over to western male technocrats in CIMMYT, IRRI and multinational seed corporations.

Miracle seeds

The masculinist breeding strategy of the Green Revolution was a strategy of breeding out the feminine principle by destroying the self-reproducing character and genetic diversity of seeds. The death of the feminine principle in plant breeding was the beginning of seeds becoming a source of profits and control. The hybrid "miracle" seeds are a commercial miracle, because farmers have to buy new supplies of them every year: they do not reproduce themselves.

The Green Revolution has displaced not just seed varieties but entire crops in the Third World. Just as people's seeds were declared "primitive" and "inferior" by the Green Revolution ideology, food crops were declared "marginal", "inferior" and "coarse-grained". Only a biased agricultural science rooted in capitalist patriarchy could declare nutritious crops like ragi (*Elusiene coracaua*) and jowar "inferior". Peasant women know the nutritional needs of their families and the nutritive content of the crops they grow. Among food crops they prefer those with maximum nutrition to those with a value in the market. What have usually been called "marginal crops" or "coarse grains" are nature's most productive crops in terms of nutrition. That is why women in Garhwal continue to cultivate mandua and women in Karnataka cultivate ragi in spite of all attempts by state policy to shift to cash crops and commercial food grains, to which all financial incentives of agricultural "development" are tied. A woman in a Himalayan village once told me, "Without our mandua and jhangora, we could not labour as we do. These grains are our source of health and strength".

Bathua

The most extreme example of this polarised vision is that of bathua, an important green leafy vegetable with very high nutritive value which grows in association with wheat. When women weed the wheat field, they do not merely contribute to the productivity of wheat; they actually harvest a rich source of nutrition for their families. However, with intensive chemical fertilizer use, bathua becomes a major competitor of wheat and has been declared a "weed" that is killed with herbicides and weedicides. The food cycle is broken, women are deprived of work, and children are deprived of a free source of nutrition. The crops that the Green Revolution destroys are thus not marginal in the context of nutrition and survival, but in the context of the market and of commodity production of food for profit.

The bias against people's seeds and people's crops translates into a bias against women's work in the production of sustenance. Since diversity works against the logic of centralization and control, genetic diversity must be destroyed. In effect, global agricultural strategies are breeding out those links in the food chain which are of high value to women's work in the survival economy and which have traditionally been under their control.

The Green Revolution in Punjab reduced food values by displacing the traditional cereal-pulse-oilseed mixed cropping patterns and reducing the production of pulses and oilseeds.

Green Revolution in Africa?

The assumption that the "miracle" of the Green Revolution can be replicated in Africa is flawed on two grounds. Firstly, India was not an ecologically ravaged continent in the 1960's like Africa is today. Secondly, the miracle was not such a miracle even in India, as the experience of e.g. Punjab illustrates.

The "miracle seeds" of the Green Revolution were meant to free the Indian farmer from constraints imposed by nature. Instead, large-scale monocultures of exotic varieties generated new ecological vulnerability by reducing genetic diversity and destabilizing soil and water systems. Punjab was chosen to be India's breadbasket through the Green Revolution, with high-response seeds, misleadingly called high-yielding varieties. The Green Revolution led to a shift from earlier rotations of cereals, oilseeds and pulses to a paddy-wheat rotation with intensive inputs of irrigation and chemicals. The paddy-wheat rotation has created an ecological backlash with serious problems of waterlogging in canal-irrigated regions and groundwater mining in tube-well irrigated regions. Further, the high-yielding varieties have led to large-scale micronutrient deficiencies in soils, particularly iron in paddy cultivation and manganese in wheat. Over the last year there have been 42 new insect pests and 12 new diseases in rice monocultures! We seem to forget to measure sustainability in nature's terms.

The fading miracle of the Green Revolution is now creating pressure for India to adopt the African strategy of export-oriented cash crop production. Growing cash crops for export has been tried elsewhere and is a proven way to be trapped into food scarcity and spiralling debt burdens.

The post-Green Revolution era

The failures of the Green Revolution are now apparent both to farmers and to those in global think-tanks. Farmers have stopped using "miracle" seeds. In Kerala, women rice farmers are reported to have said, "When we sowed only government-approved varieties, we had a loss". In the Philippines, rice farmers called the IRRI seeds "seeds of imperialism", and in Negros, they are shifting again to traditional seeds as a basis of agriculture which is ecological and equitable. As the myth of the miracle seed gets exposed, international agencies are talking of going "beyond the Green Revolution".

The post-Green Revolution era could involve a more rapid breeding out of the feminine principle by deepening trends towards uniformity and vulnerability, and transferring the control of seeds and crops from the hands of women and peasants into the hands of corporate giants. The present trends in biotechnology point in this direction.

It could, however, also be based on a recovery of the feminine principle in agriculture – consisting of a recovery of genetic diversity, self-renewability and self-sufficiency in food production, with control in the hands of those who provide sustenance.

What are the lessons from e.g. African women farmers? □

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Womens' knowledge of multiple cropping makes an important contribution to ensuring systainability. (Photo: Coen Reijntjes).

African women farmers utilize local knowledge

Monika Hoffmann-Kuehnel

The rains in the dryland zone of the lands behind Kitui, southeast of Nairobi, Kenya, have again been months too late. There is also no sign that they will come. Mama Kalakuku has to walk a few more kilometers to find any remaining leaves and wild fruits from the dry, half-naked shrubs and trees to keep her ten children and herself alive. One wonders how people can survive in such harsh environments.

This concern was the main question to be answered in a travelling workshop on "Women as Managers of Knowledge". Thirty women farmers and scientists from Kenya, Tanzania and Uganda met in August 1988 for a travelling workshop coordinated by KENGO to share and appraise traditional knowledge and skills of women in managing natural resources. The workshop was conducted in the Swahili language (with English translation) and held in villages in three different ecological zones: Kitui in the semiarid zone, Nyeri in the wet highlands, and Siaya, Bungoma and South Nyanza in the lake basin.

Knowledge of indigenous plants

The workshop revealed that the most important component of the "survival economy" developed by the women living in all three zones was their knowledge of wild and cultivated indigenous plants and ways of growing, conserving and processing them. In the dry season and especially in drought years, the women gather wild fruits and vegetables (e.g. *Vigna spp.*, *Amaranthus spp.*, *Berchemia discolor*, *Adansonia digitata*) to feed their families. The berries and leaves are usually eaten fresh, but some are also systematically cultivated and preserved for periods of scarcity. These indigenous plants are important genetic resources for sustainable landuse systems, as they are resistant to drought and diseases, do not need special fertilizers, have high nutritional value and can be used not only for food but also for medicines, fodder, fuel, dyes and fibres.

Ecologically-oriented farming

The women's traditional knowledge of multiple cropping and terracing methods make an important contribution to ensuring sustainability. For example, farmwomen from Tanzania reported how certain types of trees (*Acacia spp., Terminalia spp., Combretum spp., Commiphora spp.*) are grown together with millet, groundnuts and vegetables to prevent soil erosion and – through their foliage and root systems – to conserve moisture and soil fertility.
However, the indigenous trees and shrubs, the traditional cereal crops such as millet and sorghum, and intercrops such as black nightshade (*Solanum nigrum*) and various legumes (e.g. *Digera nuricata, Cassia singuena, Cucurbita spp.*) which contribute to a well-balanced diet are now being replaced by monocultures of maize and export crops such as coffee and tea which are promoted by agricultural extension services.
The skills of local women in ecologically-oriented landuse and their knowledge of indigenous plants – and the plants themselves – are increasingly threatened with extinction. Promotion of exotic fruit trees and vegetable cultivation and of ''modern'' value systems (''cabbage means civilization'') has led to the marginalization and depreciation of traditional foods. Since the introduction of compulsory schooling, children are learning western knowledge of little relevance to their everyday life instead of the vital traditional knowledge which their mothers could pass on to them. One workshop participant commented: ''Schooling is de-skilling''.

Women ensure survival

It became obvious during the course of the travelling workshop that the main responsibility for ensuring survival of rural families lies in the hands of women. When market and export crops are promoted on the better soils, the women's food crops are forced back onto marginal land and they have to increase their efforts. In addition to providing food for their families, they also have to tend, harvest and often also transport the cash crops grown by the men. When many of the male family members leave the villages to look for work in the cities, the women remain behind and nourish the children, the old and the sick.

Esteem of women's skills

The daily life of rural women in East Africa which was experienced and reported during the workshop revealed how women have to compensate for the negative impacts of agricultural modernization by working longer and harder. But this novel meeting of farmwomen and scientists also had an encouraging effect. The fruitful exchange of experiences strengthened the farmwomen's self-esteem in their ability to manage natural resources. Through the contact with African women scientists, they saw new possibilities of improving their working and living conditions, for example, by restoring and improving the traditional diversified forms of agriculture and by trying out different methods of storage and processing.
The workshop also gave new impetus to the participating scientists and NGO personnel. It raised the question whether we should try more often to take new, unconventional paths (such as a ''women's travelling workshop'') so as to experience the problems and strengths of rural women and to take direction from their knowledge and ideas.
The workshop ended with a huge cooking party in Siaya. All the participants spent hours peeling, cutting, pounding, mixing and tasting in order to prepare typical foods from their home areas. At the end of the day, the tables assembled from the entire village bent under the weight of numerous dishes made of indigenous cereals, vegetables, seasonings and fish. In the eating was the proof of the immense variety and tastiness of traditional African cooking. ■

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Five German women from the financing institution, the Protestant Association for Cooperation in Development (EZE) also attended the workshop, which covered questions not only of indigenous wild and cultivated plants but also of water and fuel supply, women's workload, appropriate technologies, marketing, storage and food processing. **For more information**, contact Monika Hoffmann-Kuehnel, EZE, Mittelstrasse 37, D-5300 Bonn, F. R. Germany, or Monica Opole, KENGO, P. O. Box 48198, Nairobi, Kenya.

The information provided by Vandana Shiva is based on her book ''Staying Alive'' (1989) and her lecture at the Novib conference ''South-North confrontation on ecological alternatives'', Amsterdam, 11-12 October 1989. Irene Dankelman and Vandana Shiva are planning to do some research on the issue of genetic resources, indigenous knowledge and women, and on the consequences of biotechnological development on genetic diversity and women. They are highly interested in receiving any material on this topic at the addresses mentioned below.

Vandana Shiva, Research Foundation for Science and Ecology, 105 Rajpur Road, Dehra Dun 248 001, India; and **Irene Dankelman**, Agricultural University, Department ARL, Hollandseweg 1, 6703 KN Wageningen, The Netherlands ■

Beans, beans, glorious beans

Yellow, green, brown, red, violet and a multitude of shades in between: so diverse are the mixtures of beans grown by farmwomen in Rwanda. Outside the research station, I never saw a plot with a pure stand of one variety. Each contains at least 10, sometimes up to 30 different bean varieties.
The women know their beans extremely well. They know which varieties grow best on upper slopes, on lower slopes, with shade, without shade, on sandy soils, on poorly drained soils etc. They tend to grow certain varieties on the poorer soils and others on the better soils but, in all cases, they grow many different ones in each plot. They are then assured of a yield, regardless of whether the season is unusually dry or unusually wet or – something which doesn't happen very often – simply ''average''. The women retain their own seed for the next growing season, selected according to size, shape and various other criteria which they have never needed to express, for they have selected seed ever since they can remember, learning while helping their mothers.
The Rwandan-Swiss project in Kibuye brought in some new bean varieties which had been tested on the national research station and tested them in the project area to see if the plants thrived there as well. Then we distributed the more promising varieties to local farm families so that they could try them out – not to replace the present bean varieties but rather to join them. One of the suggested varieties has actually been integrated by the local women as the so-to-say 31st variety in their bean mixtures. So now the bean market is even richer in diversity, and the women have an additional component in their bean production system. ■

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Local initiatives in maintaining biological diversity

Kenyan farmers like to grow the Ugandan aerial yam, Dioscorea bulbifera, because the edible part is on the vine, so less land is needed to grow it and less labour to cultivate it compared with root crops like sweet potato. (Photo: ACTS, Nairobi).

As expansion of agriculture jeopardizes the supply of wild plants valued as food, fuel and fodder, rural communities in Kenya are now attempting to domesticate them. Calestous Juma reveals how important these activities are becoming in local economies.

Calestous Juma

Africa is currently facing problems of extensive ecological degradation and limited economic development, resulting in reduced access to basic resources such as food and energy. Increasing social complexity, coupled with the pressures of the monetary economy, have destabilized earlier forms of socio-ecological organization, and it has become imperative for rural communities to search for new forms.

The search for alternatives, especially in food and fuel self-sufficiency, includes the introduction of plant varieties. Local communities are increasing their demand for genetic resources in forms which vary according to the prevailing production systems. Communities that prefer to maintain diversity in their subsistence base will require different innovations from, say, those being integrated into monocultural agriculture.

Some rural communities are already engaged in identifying new sources of food, fuel and fodder. The search process presupposes the existence of a diverse genetic base. A significant role is played by indigenous knowledge about local plants. This is preserved in various forms including ethnobotanical information, folklore, myths and rituals. Where certain plants are no longer used regularly, this knowledge may be lost. However, the most significant factor is the loss of the plants themselves as agricultural expansion destroys their habitats.

Genetic resources in Kenya

The current organization of Kenyan agriculture has a long history going back to colonial times. New crops were introduced to earn revenue for the colonial economy. Throughout the evolution of its modern agriculture, Kenya has continued to rely primarily on a narrow range of exotic genetic resources. Between 1964 and 1985 nearly 64% of all genetic resource accessions used for breeding were imported. Cereals accounted for almost 49% of the accessions.

However, attitudes are changing as more local communities start searching for new sources of food and fuel and re-introduce plant varieties that were neglected during the spread of high-yielding varieties. The communities are building their programmes on local knowledge and plant species. An example of local initiatives in restoring and expanding plant genetic diversity is given here.

The case of Bungoma District

Bungoma District covers 307,400 hectares in western Kenya on the slopes of Mount Elgon. The topography ranges from the Nzoia River lowlands to the heights of Mount Elgon, rising from 1200 to 4000 metres altitude. Nearly 58% of the district's agricultural land is classified as high potential and 42% as medium potential. Rainfall is ample: 1200-1800 mm annually. The biomass productivity and the organic matter content of the soil increase as one moves towards the top of Mount Elgon.

The district has considerable agroecological diversity which supports a wide range of crops including cabbage, potato, pyrethrum, wheat, maize, coffee, tea, sunflower, sugarcane, millet, beans, castor, pawpaw, pineapple, avocado and cotton. This wide agroecological range also suggests the potential to support similar diversity in traditional subsistence plants.

The Bungoma residents eat a wide range of plants, including at least 100 different species of vegetables and fruits. As children eat fruits more often than adults, they know more about their names, characteristics and locations. Women, on the other hand, are more knowledgeable about vegetables. The vegetables and fruits used in Bungoma are drawn from at least 70 genera belonging to 35 families (see Juma, Agricultural Diversity and Innovation).

Recent changes in landuse have influenced the degree to which various plants are used, altered the distribution of biological diversity and threatened the survival of numerous plants. Knowledge about indigenous plants is still present, but erosion is reflected by the growing inability of many people – particularly the younger generation – to identify local plants. The situation in the Bungoma lowlands, now under large-scale sugarcane fields, is particularly desperate in this respect.

Plant introduction initiatives

An interesting feature of genetic resource utilization in Bungoma has been the recent introduction of new plants: plants that were originally domesticated in Uganda, and plants that are being domesticated locally. One of the recent introductions from Uganda is *Dioscorea bulbifera var. anthropophagarum*. This aerial yam has several intrinsic characteristics which favours its adoption in Bungoma:

- As the edible part is located on the vine, less land is needed to produce yields comparable to those from root crops such as sweet potatoes. This partly explains why the yam is diffusing faster in households with land shortage. Although no systematic agronomic studies have been made to compare yield levels, the plant has shown its potential for widespread use.
- Since the bulbils are located on the vine, the energy required to manage the yam is less than for potatoes. The yam is easy to harvest and needs little cleaning. This partly explains why its adoption is higher in households with labour shortage.
- The yam responds to improved crop management. It is normally grown without external inputs, but preliminary trials have shown that the yield can be considerably increased with minimal inputs.

Wild plants are valued food

The main impetus for recent attempts to domesticate local plants in Bungoma has been the conversion of land to agricultural production, which gradually displaced wild plants, especially fruits and vegetables. Even though some of these traditional foods are becoming scarce, the local diets and tastes have not changed to the extent that they have become irrelevant.

Nearly 47% of the households sampled in the district routinely gathered fruits and vegetables from the wild. Another 12% tended plants in the wild, an important pre-domestication stage when information is collected before the plants are relocated to the homestead. Another 49% tended wild plants growing on their farms. Several households (32%) brought wildlings into their homesteads. Nearly 23% bought seed for local plants and a similar number reported selling seeds. These figures indicate the local efforts to domesticate wild plants and the considerable economic activity associated with local plants, an activity often not reflected in the statistics.

Local experimenters

The efforts to domesticate local plants are widespread and involve farmers, extension officers, teachers and local experimenters. The activities of the last-mentioned category are in no way linked to the formal research carried out in research stations.

While teachers tend to rely on schoolchildren to search for seedlings, some local experimenters invest time and resources into seeking plants of economic value. They take trips into forests to collect information and seedlings. Already, some plants brought from Mount Elgon, especially *Solanum* species, are being locally marketed. Because Bungoma is close enough for trips to Mount Elgon and is also a central market where new products are often tried out, there is sufficient interest and demand for local products that the experimenters stand a high chance of gaining from their efforts.

Some of the experimenters also visit research stations to get ideas on plant breeding. For example, the selection that has already been made to produce new varieties of the local vegetable, *Gynandropsis gynandara*, partly followed research-station methods. The local breeders selected for high yield, early or late maturation, and other traits such as taste and drought resistance. The seed for these varieties is sold on local markets.

Problems in domestication

One of the main limitations to domestication has been the lack of agronomic information on the candidate species. The local experimenters rely largely on wildlings gathered from the forest, as domestication is hindered by the lack of knowledge about how to propagate the candidates. For example, various households in the region have collected seeds from *Saba comorensis*, which yields a large fruit that can be used for making fruit juice, but numerous attempts to propagate the plant have failed.

The efforts to domesticate plants have sometimes been hampered by government policies. For example, attempts by some local experimenters to domesticate certain fruits had to be abandoned because of the strict enforcement of the Forests Act against any person found with forest products. Local experimenters are therefore reluctant to risk searching the Kenyan forests for suitable candidates for domestication. In a few cases, the experimenters have crossed the border to search in the Ugandan forests (not governed by the same laws, but also not secure).

Commercial exchange of genetic material

Seed for new plants is regularly brought across the border from Uganda and sold in Bungoma. This is supplemented by the regular flow of seed through intermarriage. It is common for newly-married women to bring with them seeds along with other cultural artifacts.

Most conventional views about rural activities assume that indigenous plants are used mainly in subsistence farming, which is defined in the context of the absence of commercial exchange. The situation in Bungoma shows that this is not the case and that local plants are part of the local market economy. Not only are indigenous crops increasingly being sold on local markets, but seed trade is also becoming a separate commercial activity in the area. This situation is not unique to Bungoma; it applies to most parts of Kenya.

The future of biological diversity in Bungoma and elsewhere in Kenya will depend largely on policies regarding expansion of production and response to local initiatives in plant introduction and exchange. The challenge is to create conditions which will enable the rural communities to work closely with the scientific community to improve local varieties. ■

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This article is based on the book by Calestous Juma, Biological Diversity and Innovation. For more information, contact him at:
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In the home of the potato in South America, farmers have developed an immense diversity of varieties over the centuries, but these valuable genetic resources are endangered with the promotion of "modern" potato production. Albrecht Benzing spoke with Anibal and Orfelina Correo, peasant farmers in Ecuador, to find out more about the indigenous potato varieties they are trying to maintain.

Andean potato peasants are "seed bankers"

Discussing farming problems in Ecuador. The introduction of modern agriculture, with its emphasis on monoculture and a small number of "improved" varieties, is reducing the diversity in Andean cropping. Not only numerous varieties of potatos but also numerous cereal and legume crops used to be grown together in a field. Now this is found only in the more remote areas. (Photo: Albrecht Benzing)

Albrecht Benzing

"We easily let ourselves be talked into it", recalls Anibal Correo, a peasant in the village of Boliche in Ecuador. "Agronomists came and encouraged us to start a cooperative. They brought new potato seed and mineral fertilizer and set up field experiments. Of course, in the beginning it was obvious that the new seed and foreign fertilizer brought better yields. Besides, we were used to thinking that anything coming from the gringos must be better than what we had."

I met Anibal Correa at a seminar for potato growers from different parts of the Ecuadorian highland, and then travelled one and a half days from Riobamba to Boliche in order to learn more about his farming methods and to add to our collection of indigenous potato varieties. Anibal is in his mid-40s, is married and has four children. He and his wife Orfelina grow potatoes in rotation with mashua, oca, melloco (three Andean tuber plants), field beans and barley at an altitude of 3500 m.

"Already in the second year I noticed that we were having more problems with the potatoes than we used to. And in the third year the cutworms started to increase in number. The agronomists then brought us fungicides and insecticides to fight the diseases and pests. But these inputs got more expensive each year, and you had to keep using more and more of them. Besides, the potatoes tasted bitter if you sprayed them so much."

Anibal continued: "In the cooperative, I criticized the introduced techniques and said it would be better if we went back to our old ones. But the others didn't want to listen, because they still thought that the mineral fertilizers brought better yields. That's why I left the cooperative and now work only on my own land. I began to fertilize again like we used to and before long the pests became less of a problem."

His method of fertilizing: The sheep are kept overnight in a small enclosure on the future potato plot. In this way, with very little labour input, urine and dung are deposited. After two or three nights, the enclosure is moved to another part of the plot. The sheep dung, together with feed residues and weeds, is worked into the soil with a hoe.

Indigenous potato knowledge

Anibal and Orfelina still grow (as used to be common practice in the area) over 20 different potato varieties. They know each by name and know where it comes from. They can describe the typical characteristics of the plants' flowers and leaves, and can differentiate the tubers by taste. They know which varieties are susceptible to which diseases and climatic influences. All the varieties are grown together in the same plot. ''In a dry year,'' Anibal explained, ''maybe some of the varieties don't yield so much, but then we still have the other potatoes which can put up with some dryness. In a wet year, it can be just the opposite, and we're glad of the potatoes that aren't so liable to rot. There are some varieties which are more resistant to frost, and others are more resistant to cutworms.''

Only two types of potatoes are grown in separate plots: the varieties which are difficult to peel on account of their very deep eyes and are cooked in their skins and eaten as ''kariuchu'' together with pepperoni sauce; and the yellow and red ''chauchas'', which take only four months to mature and are harvested earlier than the other varieties.

This principle of the greatest possible diversification runs like a red thread through their entire farming system. For example, the Correa family has another piece of land ''down below'' at an altitude of about 2700 m, where they grow maize, beans, peas, wheat, gourds and pepperoni. Sowing and harvest times differ according to altitude, so the work load can be spread over the year. If particularly severe night frosts result in crop losses on the higher land, the family still has maize to eat. If the maize fares poorly in a dry year, a harvest can still be expected on the higher soils with their better water-holding capacity.

An experimental plot in the highlands of Ecuador. Potatoes are indigenous to South America and were domesticated there. The national and international research institutes in the Andean countries are collecting local varieties for their gene banks. However, genetic diversity can also be maintained or restored by means of village-based systems of collecting and multiplying local varieties. (Photo: Helmut Schmidt)

Not textbook knowledge

The next morning, while helping Anibal prepare the holes for potato planting, I asked him why he made the holes so deep. In the agricultural textbooks, we had learned that potatoes should not be laid deeper than 5-10 cm under the soil surface, particularly in heavy soils. He explained to me: ''With the night frosts we have here, it often happens that even the mother tuber could freeze if she were lying too close to the soil surface.''

And why, I asked, is he making the rows at an angle to the slope? His reply: ''Judging by the weather until now, this is going to be a wet year, and the water has to be able to run off so that the potatoes don't rot.''

The detailed knowledge of Anibal and Orfelina about soils, climates and plants, and the potatoes varieties they continue to grow are of great importance for our work in Ecuador. In cooperation with the Polytechnical College in Riobamba, the non-governmental organization Eirene has been supporting investigations of traditional potato production and collection of indigenous potato varieties.

Diversity at peril

Potato growing has an extremely long tradition in this area. Over 3000 years ago, Indians near Titicaca Lake close to what is now the border between Peru and Bolivia began to domesticate wild nightshade plants (*Solanaceae*) with small tubers. From there, these tuberous plants spread across the entire Andes area, already long before the Incas established their huge empire in the 15th century. It is thanks to the efforts of these ''primitive'' Indians that eight potatoes species with thousands of varieties are now grown in the Andes and that the most important of these species, *Solanum tuberosum*, has become the fourth most important food plant in the world.

However, as a small number of high-yielding cultivars are being introduced in the course of ''agricultural development'', the diversity of species and varieties in Andean potato growing is declining. Recognizing the danger of losing valuable genetic resources, the International Potato Center (CIP) in Peru has built up a gene bank with 4-5 thousand wild and cultivated potato varieties. This material is important not only for the Andes region; new German, Dutch or Russian cultivars will be created by crossing with the genetic material from the original home of the potato.

Maintaining diversity in the field

In contrast to CIP, the small project in Riobamba is not primarily concerned with maintaining gene banks for breeding purposes. Instead, we are trying to maintain the genetic diversity on the fields of the Andean farmers themselves. We are trying to establish a small centre for the production of certified (above all, virus-free) seed from indigenous potato varieties.

Thus far, certified seed is available only from the new ''improved'' varieties, and then only in small quantities and at prices too high for most Ecuadorian peasants. We hope that, by giving the peasant families access to high-quality local seed, we will help to avoid that they one day become dependent on foreign ''miracle varieties'' and the insecticides, herbicides, fungicides, nematicides and various other ''-cides'' required to produce them.

The different indigenous varieties we collect are planted and multiplied in peasants' fields or village land at various altitudes, and the effects of diseases, pests and climatic influences are observed. Many peasants at each site are curious and interested, and those who work together with us on the trial plots receive half of the yield. Thus, some of the varieties threatened with extinction return home or find new homes. ■

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Low-demand animals for low-input systems

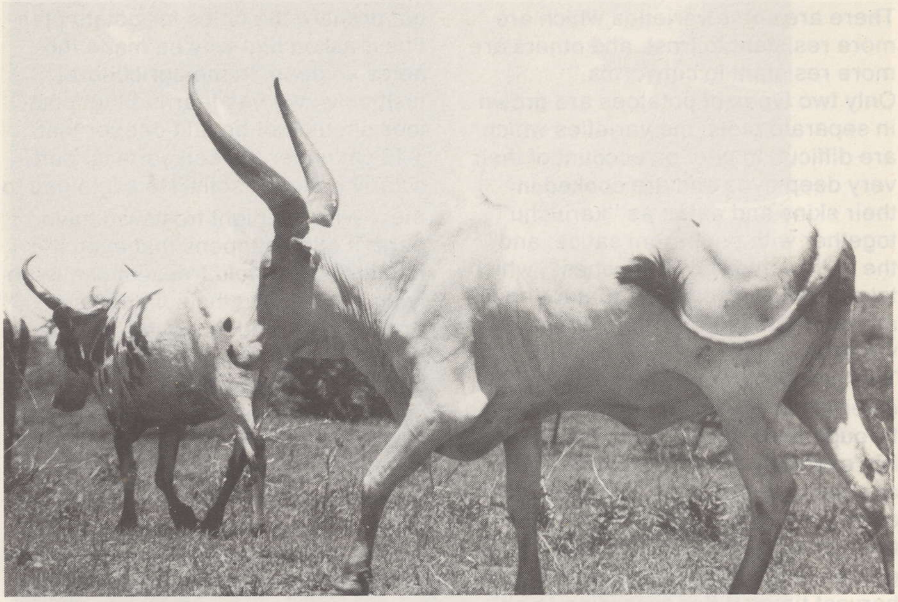
Indigenous livestock breeds are well adapted to the local environment, but have usually been underestimated by scientific breeders. Wolfgang Bayer urges that a closer look be taken at the traits valued by farmers operating with low levels of external inputs when they select and breed animals on their own farms.

Wolfgang Bayer

Animal breeding in industrialized countries is basically aimed at raising the genetic potential of animals to produce meat, milk, eggs or fibre. The success is impressive. Top cows can produce 10 000 l of milk or more; pigs reach 100 kg liveweight in 6 months; chickens lay 300 eggs per year. However, to realize this potential, the animals must be given high-quality feeds and kept free of disease; they often require housing, sometimes even air-conditioned. In other words, they need a high level of external inputs and a complex infrastructure of feedmills, breeding controls and veterinary services. The environment is manipulated to suit the requirements of the improved stock. This is also the mainstream approach to breeding science taught at universities and colleges throughout the world, usually without stressing the negative consequences of such intensive husbandry practices and environmental manipulation.

Multiple functions

Within the various systems of livestock-keeping practised by smallholders in the Third World, the functions of animals are much more complex and different species fulfil different functions. Camels, cattle and buffaloes are used to produce milk and manure and for draught or transport purposes, and also as a savings account: healthy animals are sold only when large amounts of cash are needed. Sheep and goats are sometimes milked but serve mainly as sources of meat, also on ceremonial occasions. They are more readily sold than large stock if cash is needed. They are particularly important for farms which are too small to keep large stock such as cattle or buffaloes. Poultry are generally kept in a very extensive way and are used as the "small change" in the livestock savings account. They are more often consumed at home than are ruminants. A livestock-keeping family often keeps several species such as cattle, sheep and poultry, or camels and goats to fulfil different functions.



Dinka cattle in southern Sudan. Transhumant pastoralists select, among other things, for animals that can walk long distances. (Photo: Wolfgang Bayer)

Breeding for low inputs

In farming systems with low levels of external inputs, the approach to breeding these species basically accepts the environmental limits rather than trying remove them. The local breeds are partially a product of natural selection, but the livestock-keepers also deliberately select animals for specific traits, above all, for the type of animal which can survive and produce under the local conditions. The animals must also fit into the production system. For example, in pastoral systems, animals not amenable to herding are culled. Transhumant pastoralists select for animals which can walk long distances. Generations of natural and deliberate selection have resulted in local breeds with a high degree of disease resistance or tolerance and capable of subsisting on the available feed resources, which are seasonally scarce and of low quality.

This can be illustrated by some examples. A problem encountered when European cattle were introduced into the subhumid zone of Nigeria was that the animals often died from a tick-borne disease called heartwater. Attempts to investigate the transmission of this disease in indigenous cattle proved impossible because these animals were not susceptible to it. Similarly, in Kenya dipping is vital for imported livestock but trials showed that dipping indigenous cattle to control ticks did not improve animal production. Likewise, many local livestock breeds in Africa are tolerant to trypanosomiasis or sleeping sickness. Animals adapted to low quality and availability of forage have a lower basic metabolism than animals of high genetic potential, even if there is no difference in size between the breeds. Animals adapted to arid areas use water very efficiently, can drink large amounts of water within a short time and can go for three or more days without water. This is the case not only in camels, goats or donkeys but also in certain breeds of cattle such as the Boran.

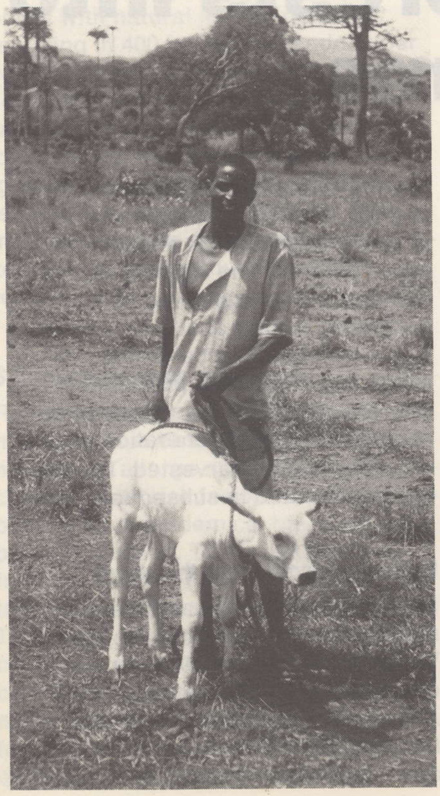
In low-external-input agriculture, these adaptive characteristics are more important than the ability to produce well under good conditions with a high level of inputs. Trials have shown that animals with high genetic potential for production are very susceptible to stresses of all kinds. Therefore, under the harsh environmental conditions in much of the tropics, indigenous animals usually perform much better than "improved" stock.

"Underestimated" genetic resources

Formal science has tended to concentrate on cattle, pigs, sheep and chickens, largely neglecting local breeds in developing countries. Much less attention has been given to camels, buffaloes and goats, which are widely kept in low-external-input farming systems. Numerous species with potentially wide ecological distribution (e.g. guinea pig, guinea fowl, pigeon, duck) and animals adapted to specific ecological conditions (e.g. llamas and alpacas in South America, yaks and bantengs in Asia) have received very little scientific attention. These indigenous livestock breeds and species may not be "underexploited" by local farmers, but they are certainly underestimated by scientists and development planners.

For the existing livestock production systems, it would make little sense to "improve" the genetic potential of these species by breeding under artificially improved conditions for higher production. This would only lead to the same problems encountered with highly bred cattle, pigs or poultry. An intensive selection process for 40-50 years would undoubtedly produce camels and buffaloes capable of giving 5000 kg milk annually, but their feed requirements would differ little from those of a cow giving a comparable yield. Also the recent scientific interest in domestication of wildlife such as antelopes, which are better adapted in their feeding behaviour to savanna areas than conventional domesticated ruminants, is more suitable for large ranches than for small farms and is of little positive value in the context of low-external-input agriculture.

Bami raises Bunaji (White Fulani) cattle in the subhumid zone of Nigeria. He observes how his neighbours try out new cattle breeds before deciding whether to try them out himself. (Photo: Wolfgang Bayer)



Research and development

Livestock research and development to benefit smallholders who choose or are obliged to operate with low levels of external inputs should not give high priority to breeding. Instead, efforts should concentrate on explaining how livestock-keeping is presently being done, identifying major constraints (e.g. seasonal nutritional gaps, or diseases to which the animals are not tolerant) and trying to overcome these constraints so that the local livestock can produce more and continue to fulfil their various functions within the farming systems.

However, because changes in economic and environmental conditions may favour the use of different types of animals, the genetic resources desired for livestock production can change. For example, high demand for dairy products favoured crossbreeding of indigenous cattle with European breeds in Kenya and India. Livestock-keepers in central Nigeria started to experiment with crossbreeding their cattle with larger breeds from northern Nigeria (see box). Where this occurs, formal science should support such efforts by smallholders so that they have additional options in developing the livestock component of their farming systems. This support could include importing animals from other countries or regions and crossbreeding, but only if the superiority of the new breeds to existing breeds under local conditions can be proven. ■

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Bami, a Fulani cattle-keeper in central Nigeria, was asked for his views about an experimental unit of Holstein-Frisian X White Fulani (Bunaji) crossbred cows kept by the International Livestock Centre for Africa (ILCA) in his neighbourhood.

AWB: Your neighbour has been milking the crossbred cows. Has he told you how much milk they are giving?

Bami: Right from the beginning, when the crossbreds were brought here, I thought they might give more milk than our Bunaji cows.

AWB: Why did you think that?

Bami: I thought, these animals will give milk like the Bokoloji [Sokoto Gudali] cows. I could tell just by looking at their eyes. I know many different breeds of cattle, at least ten.

AWB: If you know that the Bokoloji cows give more milk than your Bunaji ones, why don't you keep any Bokoloji?

Bami: I always thought that it was too wet here for them. When the rains come, the Bokoloji always go back north. But recently I've seen that some Fulani around here are trying out Bokoloji animals in their herds.

AWB: And how are these animals doing?

Bami: They seem to be doing fine. Alhaji bought two and Magaji also has one. I'm watching these animals.

AWB: What do you mean by that?

Bami: I'm waiting and watching. I'll wait until they have spent two wet seasons here and if they are still doing fine, then maybe I'll buy a couple of Bokoloji for my herd.

AWB: ILCA has been trying out crossbreds in this area for four years now. Have you been watching them, too?

Bami: The crossbreds seem to be doing alright, but I've noticed that they're given lots of care: the place where they're kept is always cleaned, they get plenty of extra feed and they're given medicine whenever they need it. I'm not sure whether we Fulani would be able to give all these things. We can't always get medicines when we need them. When we try out new animals, they have to live just like our other animals do.

Source: Ann Waters-Bayer, field notes, Abet, 21 Nov. 1984.

Reptiles are a source of protein in many parts of the world. Promoting iguana management for local food and sales can encourage the protection and planting of farm forests where the iguanas can live. Dagmar Werner describes how the Smithsonian Tropical Research Institute, the Pro Iguana Verde Foundation and rural communities have been investigating the potentials of this underexploited resource.

Dagmar Werner

Agricultural practices are one of the main causes of deforestation and consequent reduction in the quality of life for rural Latin Americans. Farmers slash and burn untouched forest to grow basic crops such as corn, rice or beans. Three years later the clay soil is largely depleted of its nutrients and the farmers move on to cut new forest. The used land is sold to cattle ranchers, and the soil is further degraded (Gradwohl and Greenberg, 1988).

If agricultural production can be enhanced by incorporating forest ''shelter-belts'' into existing agricultural systems, farmers will protect their forest rather than cutting it.

The green iguana has been hunted to extinction in many areas of its range (Mexico to Paraguay) because it is highly prized by native people as a food source (Fitch et al., 1982). Iguanas depend on trees for habitat and food.

Fitting iguanas and forests into Central American farms

Studying the iguana

Basic research, initiated in 1983, focused on the reproductive behaviour of the green iguana. This research led to development of new management procedures and technology associated with egg laying, incubation and dietary supplements. As a result the reproductive potential of the green iguana is greatly enhanced; survival of large numbers of hatchlings is assured. Young iguanas reared, in captivity, are released at seven months. Because of the loss of forest in agricultural areas, trees must be planted to provide habitat and food for the iguanas. Selected tree species must be useful to the farmer and planted in a way that does not interfere with ongoing agricultural activities (Stoney, 1987). Recent research indicates that meat production from iguana may be up to three times that of cattle per hectare.

Iguana management

Based on this research, a basic iguana management model was developed to permit sustainable use of this resource. Sites receive genetic brood stock with enhanced production capabilities from the centre. Reproductive colonies are established near farm houses. Specially designed feeding stations are set up to provide the supplementary feed that permits maintenance of iguana densities ten times higher than would occur naturally. Egg-laying sites are installed with specially designed nests from which eggs can be easily collected for incubation (Werner and Miller, 1984). Simple incubation chambers and rearing cages are installed to permit optimal hatching rates and numbers of young available for release into forest patches. The survival rate of iguanas is thus multiplied 45-fold compared to natural survival, resulting in an equally accelerated rate of rebuilding the iguana population (Werner, in press). Two years after release of the first generation of iguanas, they can be harvested. The cycle can be repeated in subsequent years.

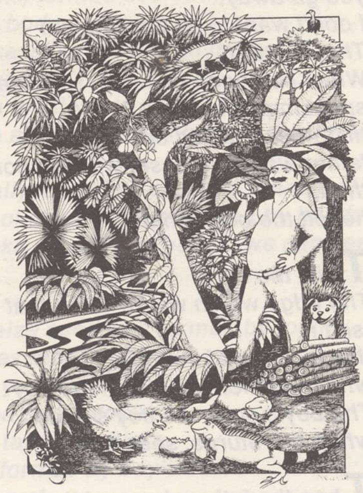
Farmers welcome back the iguana

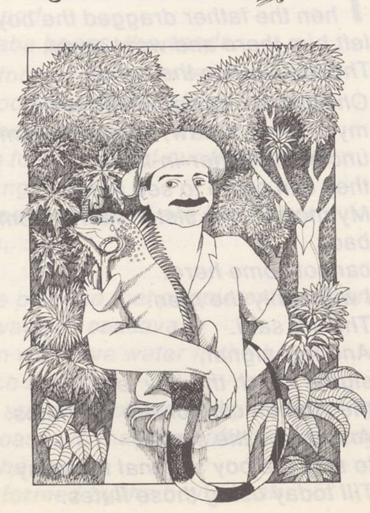
Implementation of iguana management was initiated by the Pro Iguana Verde Foundation in 1985 in rural communities in the Peninsula de Azuero, the most deforested area of Panama. Farmers are enthusiastic about the return of the iguana and are

planting mainly native multipurpose trees to provide additional habitat for the reptile. The trees are selected on the basis of their usefulness to the farmers in the region and are planted as shelter-belts.
In Chupampa and Llano Grande, 15 tree species were selected, including five species of live-fencepost trees (*Bursera simaruba, Diphysa rabinoides, Erythrina poeppigiana, Gliricidia sepium and Spondias mombin*), five species of fruit trees (*Anacardium occidentale, Crescentia sp., Inga sp., Psidium guayaba, Tamarindus indicus*) and five species of timber trees (*Acacia mangium, Bombacopsis guinatum, Cordia alliadora, Cedrela odorata, Leucaena leucocephala*). The trees are planted along water ways or along existing fencepost lines in 20 m wide strips.
As iguana management is further investigated in collaboration with the farmers, its environmental and economic feasibility becomes ever more evident. The low energy requirements of iguanas result in very low consumption of purchased feed while they are in captivity. After release they eat their natural diet: leaves, fruits and flowers from the trees. This is a resource for which no domestic animal competes. If feeding stations are set up in the management areas, feed consumption will still be less than half of that required to raise a chicken or rabbit to the same size, as the iguanas supplement their natural diet with the purchased food.
Although it is not a necessary component of iguana management, the supplementary feed permits a ten-fold increase in the carrying capacity compared with natural iguana densities, resulting in 400 harvestable adults per year and hectare. In view of the present sparsity of trees in the agricultural areas, the production of minimum to maximum numbers of harvestable iguanas can be planned by altering levels of feed supplementation. This may be crucial to supply local markets with a desired quantity of the reptile.

Still much research to be done

Research on iguana management must continue before it can be implemented on a large scale. This is because crucial risk factors, such as the possibility of epidemics, have not yet been addressed. There is also need for long-term research on the type of trees to be proposed for reforestation. The use of tree species varies from country to country and also within a country. The trees must offer the iguanas a balanced diet if supplementary feeding is not planned. The food requirements of iguanas need to be assessed and the nutritive value of the tree products identified in order to select appropriate combinations of tree species. If, for economic reasons, trees are selected that do not offer a balanced diet, feed supplements can be formulated which contain only those elements which iguanas do not find in the reforested areas.
To adapt iguana management to varying socioeconomic and environmental situations, the Pro Iguana Verde Foundation works closely together with the Regional Program of the International Union for Conservation of Nature and Natural Resources (ORCA, IUCN). Presently, iguana management is being implemented in Panama and Costa Rica. Implementation and adaptive research in new countries and at new sites will be coordinated with the ongoing activities of IUCN and other organizations concerned with the sustainable use of natural resources.





Multiple benefits

Iguana management has the potential to provide a number of social, environmental and economic benefits. The species is conserved while at the same time a protein source is provided to local farmers. Iguana products, such as meat, eggs and skin can be sold on local or international markets. The re-establishment of forest in agricultural areas provides tree products to the farmers (fuel, wood, fruits, timber) and simultaneously protects soil and water resources. The reforestation efforts do not aim at creating virgin forest, but rather at providing those resources upon which the farmers' well-being depends. Reforestation with a diversity of trees will also attract other animals and thus create diversity rather than monocultures. Implementation of iguana management in buffer zones of protected areas may become an effective tool to conserve biodiversity, as farmers will be able to satisfy their basic needs on the land they where live, rather than destroying new areas of untouched forest.
The idea of wildlife management and conservation through sustainable use of natural resources is growing. In Costa Rica, scientists and students of the Wildlife Management Master's Program of the National University at Heredia are jointly addressing the environmental problems by training and research into new possibilities of sustainable use of natural resources as exemplified by iguana management. ■

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MYTHS?

Can they be useful in agricultural development work? ... outsiders with a key to understanding local perceptio... vividly illustrated in the myth of the Nambikwara India... Grosso in the Amazonian region of Brazil. The myth ... recorded by Mara Vanessa Dutra, and translated by T...

The origin of

It was like this, this story:
These, the plants which we have here
in the tribe, it is said that it was like
this in the beginning, in order to have
them:
The cassava, which we see, the
cassava leaves – five leaves, look like
hands of people. Now I will begin from
the beginning.

There was a boy, of about thirteen
years of age.
This boy had a father.
He went with his father to the forest,
but before there was nothing of this
we have today,
there was nothing of cropping.
Imagine how they lived, these people.
It was really the beginning ....

Then he went with his son to the
forest.
First thing he did (the boy):
he urinated, he felt like it, then he did
it,
he urinated.
White foam.
The boy looked at his urine and said:
Daddy, here, my pee is foaming,
it looks like foam of cassava chicha.

Second thing he said to his father,
he saw the carrier, it is carrying that
leaf,
then he said to his father:
Oh Daddy, the carrier is carrying what
looks like cassava leaves ...
It seems that at that time, there were
people like us today, doesn't it? It
seems ... but nobody knew what
cassava was.

At that moment, the father had not
yet become angry with the boy,
not yet.
He thought he was joking,
playing around, you know.
Then again, a third thing happened:
Another type of carrier which takes
earth from the depths, those whitish
things in the forests, big and like a
ball, he brings up what looks like
polvilho.
Then he, the boy, said:
Look father,
the ant brings up what seems to be
polvilho!
The father still did not believe.

The fourth thing, he asked the father
to step to the side ...
Oh Daddy, let's stop here,
inside the forest.
The boy looked at the bush and said:
Oh Daddy, the forest is so beautiful, a
beauty, it seems a place of cultivation.
He said.

Astronomia do
Macunaíma

And then he continued:
Father, do you hear the noise of flute?
You do not hear it yet?
The father answered:
I am not hearing it, I am not!
But yes, I'm hearing it,
said the boy,
and went on five, four times.
Then the boy spoke again:
Please drag me,
throw me like that,
leave me,
you go away.
I don't want to go back home!
That he said.
When he began like that, speaking,
speaking, speaking,
till father was fed up,
father was very upset with his son,
then,
he left the boy behind ...

This, the roca
The edge which we do – like that –
isn't it,
this the side of the boy,
which was formed out of the boy.
The boy's soul, the boy's body,
when he returns, sees this ...

Then the father dragged the boy,
left him there and went away.
The boy said to the father:
Oh Daddy, you can come with
my brother-in-law, my brother, my
uncle, my father-in-law,
they can come to see me.
My mother, my sister cannot come
back,
cannot come here.
I want only the men.
This he said.
And this signal,
signal which the boy left,
the women cannot see the flutes.
And this is the signal,
to stay the boy's signal till today.
Till today using those flutes.

This meanwhile which is the flute,
the boy's soul is always,
it never finishes.

Then the boy said:
You can go away.

The father went home very upset.
When it is our children, son of man,
we like them very much, isn't it so?
Because they were not just found in
the bush,
like any other thing.
The father was the one who made the
son, wasn't he?
He cannot leave it like that,
abandoned,
much less kill him!

He went back very very upset.
He arrived,
told the brother of the boy,

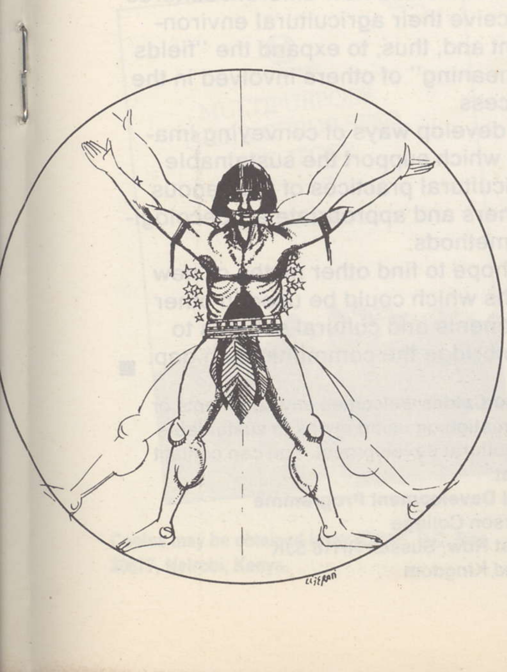
k? At the very least, they provide
ions of the environment. This is
dians, who live northwest of Mato
n was told by Lourenco Nambikwara,
y Tadeu Caldas.

f agriculture

the brother-in-law of the boy,
uncle of the boy.
That man told them:
I left my son, I was angry,
I left him,
but I don't know what he is going to do.
Let us go and see!
He said he doesn't want women to go to see him.
He said only the men.

Then the brother-in-law of the boy,
the uncle, his brother,
they went.
They went a good distance,
till they heard that noise of the singing of the flute,
where father left his son.
Ah, there it is!
He is there,
Let's see what he does there!
They went,
but did not find so soon.
Was there, at the mouth of the flute,
when he went in this direction ...,
the other side like that ...,
there he is!

Sol



They went there,
four, five, six times.
Found
four beautiful flutes,
the ones made of calabash.
There were eight, weren't there?
that they found.
But,
don't see the boy any longer.
Then came the thrill,
they found those plants ...
Then the father said:
What is it?
Where is my son?
Nothing of his son.
Then he saw those beautiful flutes,
the plants,
everything, e v e r y t h i n g,
they found everything made.
Roots with tops
and everything was there.
They found.

First they plant roots,
it all went rotten.
Then they saw that the branches,
the stick they threw,
it sprouted.
Ah, that is it!
Then he took it,
and planted it entirely in the ground,
it sprouted, gave roots.
Here he started making roca.

Plants formed everything from his (boy) body.
The cassava stem from the boy's spine;
when the flesh is gone,
there are only bones here in the spine ...,
it really looks like cassava branches!
Leaf of cassava was formed by hands.
It looks indeed like hands, we can see it!

Maize seed was formed by tooth.
It does look like it.
This yam which you are eating,
t'is bags of people.
This taia, our sticks,
was formed by boy's stick.
This pod,
big faba beans, the seeds,
was formed from the boy's eyeballs.
The pod was formed from his ears.
The peanuts we have here,
were formed out of our finger nails,
his finger nails!
The peanut's shell are like finger nails.

The polvilho that people extract from the water of cassava,
when we leave water in the bowl,
starch settles.
This starch was formed by miolo.
The cassava mass left after squeezing out the juice
was formed by the boy's flesh.

Calabashes formed by the head,
round, really similar.
Tobacco seeds were formed
by the eggs of boy's hair bugs.
The other type of yam, like a liver,
it is really his liver.
Urucum was the blood.
This arrowroot, the straight and round type,
a bit long, yes?
came out of the canela, this bone here ...

The cassava roots,
they came out of his arms.
Also the ribs became bean pods,
you know those beans, don't you, the long ones ...

He formed all the plants from his body!

Then that's why we have it.
The story of the crops which we have here,
it is said it was like this.
That's why, those flutes which they have,
which they use for their work.
I felt like showing it to you,
telling you about it, its history ...
He takes the flute with him to the roca,
he works there.
The women stay home, get the cassava,
make chicha, more or less at this time,
when the rooster sings.
He comes back from the fields with the flute,
and drinks lots of chicha.
He hides the flutes from the women.
It is a celebration, a party,
the land work's festival!

The flute, as you saw it,
is like this, they say ...
That's it. Basta.

chicha: cassava beer
carrier: ant which carries leaves after cutting them off the plant
polvilho: very fine starch extracted from the cassava tuber
roca: planted forest clearing in slash-and-burn agriculture
bags: scrotum
stick: penis
miolo: brain matter
urucum: Bixa orellana
canela: leg bone
flute: Nambikwara flutes are made of small gourds, have three holes and are blown with the nose. They produce a very subtle sound. The men play them when working the fields. No women may look at them or hear them.

Genetic diversity, mythology and agroecology

"Origin of agriculture" by the Nambikwara is part of RDP's collection of myths of indigenous peoples in the tropics. Through them we can better understand how people perceive the way their universe is organized. Indigenous peoples have comprehensive myths which include all natural or supernatural phenomena experienced by the community.

Tadeu Caldas

The communication gap

One of the biggest challenges facing people involved in sustainable agricultural development is communication with small farmers. There is a large gap between the western reductionist and analytical thinking of the scientist, and the non-western holistic and phenomenological thinking of the peasant. In the last 10-15 years, agricultural development sciences made good progress toward narrowing this gap. Research institutions are studying indigenous farming systems, but we still have to develop new research methods to deal with the complexity of these systems, once rejected as irrational. Agronomists have to widen their fields of knowledge and experience to incorporate the new concepts and practices.

We are still struggling in our attempts to see the world through the farmers' eyes. One specialist regards the farmer as a producer of commodities, another as a social subject. Another sees only the plants. Farming Systems Research represents an attempt to combine all these separate ways of experts' perception, to expand the "field of meaning" of the team so that the farmers' realities can be better understood. Results are not yet optimal.

Myths versus science

A main characteristic of sustainable agriculture is diversity. Science has gone a good way in trying to explain the complexity of agroecological systems. We have been trying to develop a way of explaining the benefit of ecological agriculture by means of abstract images, which can be grasped by scientists who are used to dealing with simplified models and reductionist analysis. We speak about increased homeostasis, allelopathic influences, land-use ratios, gradients of light, risk spread etc.

At the field level, the extension worker has to face a farmer who relates to the world in another way. They tend to explain their world by using analogies to experiences close to them. They do not abstract from the phenomena at hand. In many cases, the relationships they make between natural phenomena go beyond our own logic, falling into "magic" explanations. Scientific scrutiny of earlier magic explanations have sometimes led to validation, pointing only to the differences in "fields of meaning" between scientists and peasants. Much good observation by farmers has been disregarded. A good example is the case of a dispute between a scientist and a Brazilian Indian about bees:

The Indian, after identifying correctly a dozen species, was challenged by the scientist who said the bees shown were taxonomically of the same species, not two different ones as claimed by the Indian. The scientist sent the samples to a specialist who, by using powerful microscopes, confirmed the Indian's claim. When asked later how he knew the bees were different, the Indian showed the scientist how the bee's hives opened in different directions (personal communication, Warwick Kerr, Curitiba, Brazil, 1978).

Examples like these are abundant and sometimes not so harmless as this one. The clash of perceptions has also claimed lives and caused environmental disaster.

The Nambikwara myth

The myth of the Nambikwara explains traditional practices in a vivid way. It provides several levels of validation of action. We see in the story that: The men have to come together to the forest to clear it for planting. All parts of the body of their "civilization hero" must be planted so that his spirit can "incarnate" the fields. If they play their magic flutes while working, the "spirit" of the boy will find his "body". The family will provide food for the community. If they fail to perform the rite, the result will be no food, no celebrations, illness and hunger. The spiritual, moral, cultural, social, artistic, economic and ecological dimensions of the farmers' life are

respected, re-enforced and interwoven. From an agroecological standpoint, nothing is lacking. The analogy between the crops and the parts of the body which must be re-composed and re-organized each time validates genetic resource conservation, multiple cropping with its aspects of pest control, soil conservation, dietary balance, food self-sufficiency, and the concept of farm organism and farm individuality (also important in biodynamic agriculture).

When telling this story to members of other indigenous groups in Brazil with less diverse agriculture, I was met with immediate understanding and enthusiasm – enthusiasm at gaining fresh instruments to validate new practices which can enhance the meaning of their life as a whole, as people of the forest and also as farmers.

Old and new myths

Some of the aims of studying agricultural mythology arise out of a double need:

- to understand how different cultures perceive their agricultural environment and, thus, to expand the "fields of meaning" of others involved in the process
- to develop ways of conveying images which support the sustainable agricultural practices of indigenous farmers and appropriate agroecological methods.

We hope to find other myths or new myths which could be used in other continents and cultural settings to help bridge the communication gap. ■

Tadeu Caldas welcomes any comments or information on using myths in sustainable agricultural development. You can contact him at:
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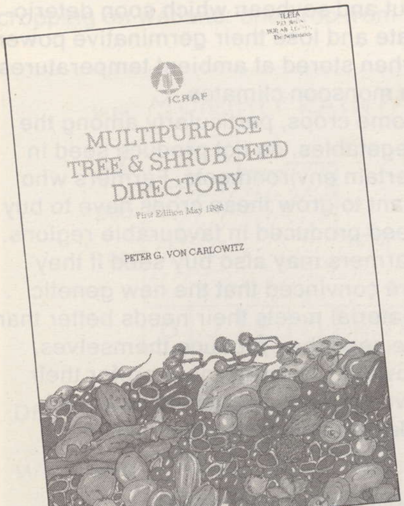
Indigenous knowledge on tropical trees

A lot of knowledge about trees and their products is still not identified. P.K.R. Nair points out that agroforestry can be a viable option to make use of "underexploited" species in a sustainable manner. He presented his views at a World Bank meeting in Washington, D.C. on June 21, 1989.

P.K.R. Nair

In the past, tropical forest management has been almost exclusively focused on timber production options. In addition to the industrial wood, natural forests also provide a myriad of other products essential for human survival, health and trade. But little attention has been given to these so-called ''secondary'' products, by both the people who destroy the forests, and those who try to protect them. One of the essential aspects of a sound forest management strategy should be to exploit such useful products in a sustainable manner without accelerating the already alarming rates of deforestation.
Our information on these secondary products and underexploited species is highly incomplete. Thousands of plant species in the forest ecosystems remain yet to be identified, let alone ''exploited''. However, even this incomplete information base indicates that these secondary products such as foods, fibres, medicinal products, essential oils, gums, etc. play a critical role in meeting the essential needs of indigenous populations. Most of these products are labelled as ''secondary'' because forest management has conventionally been for production of commercial timber (or other preferred commercial products), and the plants that produce these products are not always preferred timber species. Moreover, the methods of collecting, processing and using their products are very location-specific. Indeed, many of these products, the plants that produce them, and the processes involved in preparing and using them are seldom known outside their usual habitats of occurrence.



Copies may be obtained from: ICRAF, P.O. Box 30677, Nairobi, Kenya.

Viable option

The agroforestry approach to land management offers a viable option to make use of the indigenous knowledge about such underexploited species and integrate them with other preferred species for the production of multiple outputs and services from the same unit of land in a sustainable and socially acceptable manner. Several such plants are already known to exist in many indigenous agroforestry systems in different parts of the tropics and subtropics palms, bamboos, fruit trees, medicinal and aromatic plants, etc., to name a few such groups. Most of these provide multiple products (and services), often in repeated harvests at annual or shorter intervals; many are nitrogen-fixing and/or have other soil-improving attributes, and all of them thrive in association with other herbaceous and woody species.
Undoubtedly one of the greatest opportunities in biological conservation and productivity improvement in the tropics lies in exploiting these lesser-known species to develop appropriate agroforestry systems, making proper use of the indigenous knowledge. ■

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***Ed. Note:** The second issue of ILEIA Newsletter 1990 will focus on agroforestry (see page 35). Experiences that you consider relevant are more than welcome. Particularly those of Third World authors. The focus could be on actual practices of Third World farmers, on participatory experiences with farmers and e.g. assessing the (economic) viability of agroforestry at farm level and regional/national level.*

The trees for the forest

After several months of intensive review and solicitation, CIKARD has completed a first draft of a bibliographic study of indigenous technical knowledge relating to tree management. In the bibliography, Gerard McKlernan and Evelyn Matthias-Mundyl report on practices relating to individuals and their families or kin groups.

While the bibliographic essay is directed toward a general forestry audience, it will also be of interest to development workers. The descriptions of traditional tree practices are arranged in the order of occurrence during seedling to tree growth. The report is augmented with highlights from particularly significant publications.
The study synthesizes the view of numeral natural and social scientists who have worked with indigenous people for the last seventy years. It presents irrefutable evidence that many non-Western societies have developed sophisticated resource management strategies which are both productive and ecologically-sound.
A variety of practices in each category are reviewed. These include: choice of trees, selection of planting site, spatial arrangements, indigenous methods of grafting, pruning, pollarding and thinning, coppicing, and mulching.
While no date has been set, publication is expected in late 1990. Materials are still welcomed for the second draft.
More information from: Ms. Olivia Muchena, CIKARD, 318B Curtiss, Iowa State University, Ames, Iowa 50011, USA. ■

Gerard McKlernan and Evelyn Matthias-Mundy

Variety choice and seed supply by smallholders

Plowing a rice paddy in Java, Indonesia. Soybean is grown after rice on the wetland during the dry season. (Photo: Hallandse Hoogte/Jan Banning)

Small farmers' methods and criteria in choosing crop varieties and ensuring seed supply need to be studied so that breeders can support these efforts and produce appropriate new varieties. Anita Linnemann and Jan Siemonsma describe how this is being done in East Java.

Anita R. Linnemann and Jan S. Siemonsma

Ever since new varieties of food crops have been introduced in developing countries, at least some farmers have started to use them. However, smallholders who choose to use these new genetic materials generally do not replace them after a few years when they have lost their varietal purity. Instead, the farmers select and save seed from their own fields and exchange seeds locally. It has been estimated that at least 80% of the planted seed of the main food crops grown in developing counties is produced by the farmers themselves (Delouche, 1982).

Differing criteria

Plant breeders develop varieties according to a number of criteria, primarily yield potential but also response to fertilizer, resistance to pests and diseases, length of growth cycle, dietary value of the product etc. These varieties are generally appreciated by market-oriented, larger-scale farmers growing the crop in a pure stand and under relatively good growing conditions.

Subsistence-oriented farmers require varieties with a good yield which is reliable and stable, also during bad years. For this purpose, they commonly use a mixture of varieties. They choose varieties adapted to specific characteristics of their farming system, such as intercropping, staggered harvesting, seasonal availability of labour. They also attach importance to taste and cooking qualities and to byproducts that can be used, e.g., as forage or building materials.

Producing and selecting seed

Different farmers produce and select their seed in different ways. Most farmers select seed after harvest. Others make their choice before harvest, walking through the fields and marking the plants they will use for next year's crop. Some farmers grow seed plants for the next season in a separate plot at some distance from the main crop. They may give extra attention to this plot, for example, by applying manure, discarding off-types and keeping the plot free of weeds and pests.

The farmers do not necessarily select for a uniform type of seed. They may choose seed so as to maintain a certain variation in earliness, shape, colour and taste of product.

Need for seed purchases

In general, farmers save enough seed to resow at least twice. However, in drought-prone areas, they often run out of seed and have to depend on seed from other sources. They also have to buy those seeds which they cannot store adequately, e.g., groundnut and soybean which soon deteriorate and lose their germinative power when stored at ambient temperatures in monsoon climates.

Some crops, particularly among the vegetables, do not produce seed in certain environments. Farmers who want to grow these crops have to buy seed produced in favourable regions. Farmers may also buy seed if they are convinced that the new genetic material meets their needs better than the seed they produce themselves. However, most farmers prefer their own varieties because these are adapted to their farming system.

Farmer-based seed supply

In view of the diversity in the wishes and requirements of small-scale farmers with regard to crop characteristics, there is a need to strengthen farmer-based seed supply at the community level. First of all, researchers must acquire a thorough knowledge of the existing varieties and the existing techniques of seed production, selection and storage. Then, by conducting on-station trials as well as on-farm trials in close collaboration with the farmers, improvements could be tried out such as in seed selection in the field and in the treatment and storage of seed, and appropriate new genetic material could be incorporated into the farming system.

Case study: soybean seed supply

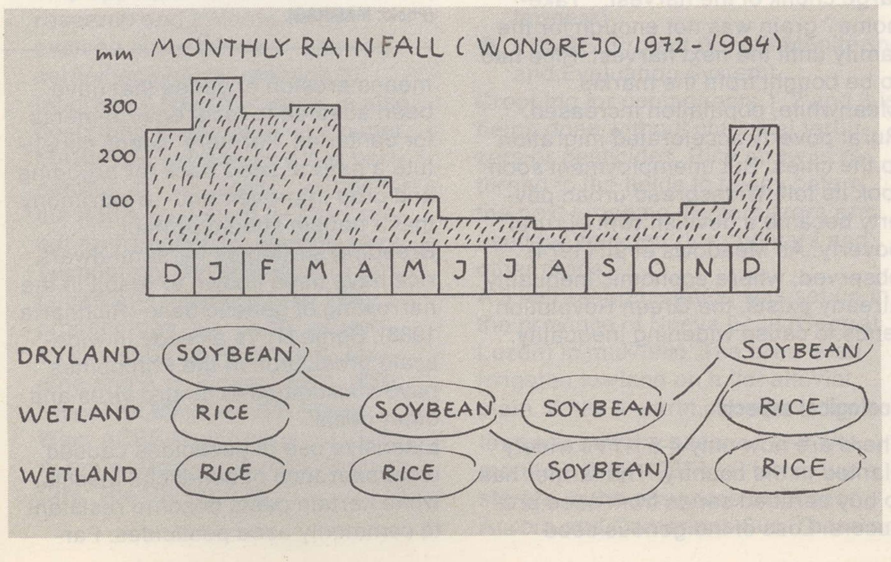
Since Indonesia has achieved self-sufficiency in rice, the Government has started to promote the growing of other food crops, particularly soybean. The main soybean-growing province is East Java, where 37% of the national crop is grown.
The extension service recommends the use of a new soybean variety with a 100-seed weight of 10 g. However, most farmers in East Java still use local soybean varieties, which they generally call "local 29". This refers to the variety No. 29 with small, green-yellow seeds (100-seed weight 5-8 g) which was introduced from Taiwan to Indonesia in 1924.
Variety No. 29 was maintained at Indonesian research institutes but was not multiplied and distributed by Government services after its initial introduction at the farm level. Sixty years of intensive cultivation and selection by Indonesian farmers have led to the development of a large number of local varieties which differ in terms of time to reach maturity and yield levels.

Maintaining seed supply

About 70% of the soybean production in East Java comes from dry-season cropping on wetland: one crop from April to June following a rice crop, and another from July to October, following either soybean or rice. The other 30% of soybean production comes from wet-season cropping on dryland between December and February (Soegito and Siemonsma, 1985). The farmers have difficulties in storing soybean seed so as to maintain its viability for more than about six weeks. To obtain good germination and establishment of soybean after a rice crop, they need access to fresh seed. To achieve this they developed a system called JABAL "Jalinan Arus Benih Antar Lapang", which literally means "seed flow between fields" (see figure). Certain villages have specialized in soybean growing on dryland during the wet season. Yields are lower than those of dry-season soybean, but farmers can get a 50% higher price for their wet-season crop, for it provides the seed for the main soybean crops in the dry season.

Local varieties compare well

Trials at MARIF (Malang Research Institute for Food Crops) revealed that some farmers' varieties of soybean compare well with those recommended by international institutes and the Indonesian Government (Siemonsma and Soegito, 1985). In on-farm trials the most promising farmers' selections were then compared with varieties developed by Asian research institutes as well as with the stock of the original variety No. 29 maintained by Indonesian research institutes.



The main soybean growing period is in the dry season, when soybean follows soybean or rice. However, soybean must also be grown on upland plots during the wet season, so that seed is available for the next dry season. (Adapted from Soegito et al. 1986)

The selected local varieties performed as well as the new varieties during the main cropping season (the dry season) and generally outyielded them during the wet season. As the seed flow from dryland to wetland and back again is indispensable for sustaining soybean cultivation in East Java, varieties must yield well in both seasons. It was noteworthy that the selected local varieties also outyielded the original variety No. 29 from which the farmers had derived them.
The results of the on-farm yield trials demonstrated that many locally developed varieties are well adapted to the local environmental conditions and farming systems. Large-scale introduction of a few varieties could cause the rapid loss of a valuable source of genetic diversity, especially since soybean seed soon loses its viability when stored under farmers' conditions.

What does this mean for research?

Soybean improvement programmes should start with testing local planting materials. It is not sufficient to compare introduced varieties with just one or two local controls, as this does not do justice to the diversity found in farmers' varieties. Instead, researchers should use fresh, healthy planting materials carefully chosen to reflect local diversity and potential, and should evaluate these materials according to the farmers' selection criteria. Progress may be slower than relying on easily available seed from international institutes but will be more secure in the long term. ■

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Farmer-based research for sustainable rice farming

Angela Briones and her colleagues

Small farmers are recognizing that the "miracle" rice of the Green Revolution is not bringing them profit. Angelina Briones and her colleagues of the ULPB describe how rice farmers, NGOs and scientists are working together in a new form of research to satisfy the farmers' desire for productive and sustainable agriculture.

The term sustainable agriculture recalls the farming practices of Filipinos in the past. Farming was an inherited art molded through time by the collective culture and experiences of farmers in an given sociocultural setting. Rice is the people's staple food. The unschooled farmer learned to be self-sufficient in this crop, having direct control over production inputs, particularly seed, to plant in the next season. Thousands of rice varieties used to be grown countrywide.

Rice fields abounded with additional food such as fish, frogs, snails and crabs. Various other field crops were grown after rice, particularly around the farmhouse. The carabao produced fresh milk for the children; backyard livestock and poultry served as "live savings" for household necessities. Animal manure, crop residues and legumes enriched the soil. The Filipino farmer had a sustainable system of food production.

However, poverty, deprivation from social services and subjection to political manipulation was also a part of rural life. The government had to import supplementary rice whenever there was widescale crop destruction by typhoons.

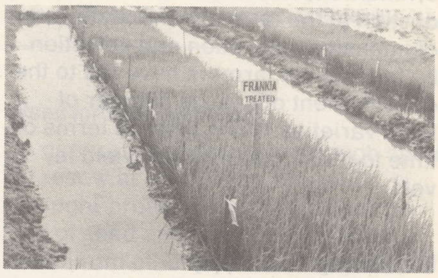
Top-down policy

In the 1960s the Green Revolution set foot in the Philippines through the establishment of the International Rice Research Institute (IRRI). The government cut off support for local rice research and depended on IRRI for technologies. Meanwhile, rice imports had to be increased for the rapidly expanding urban centres.

Upon the release of IRRI's high yielding varieties (HYVs), the government became a foremost advocate of the Green Revolution.

HYVs and associated production technologies were demonstrated countrywide. Bank loans for inputs were made available to farmers. HYV production became widespread in areas where irrigation infrastructure assured two rice crops per year. Average rice yield per cropping season increased from 1.7 (before HYVs) to 2.5 tons/ha.

Farmers practising the art of crossbreeding. They are developing their own crosses from their own selection of parental materials for the first time in Philippine history. (Photo: MASIPAG)



Biofertilizer trials are being conducted by inoculating the soil with the N-fixing actinomycete, Frankia. This is a component of the MASIPAG project in farmer-NGO-researcher partnership. (Photo: MASIPAG)

What happened to the farmers?

For several years, the farmer fully embraced the government programme. HYVs were thought to be a deliverance from poverty. But then he realized that a big harvest also meant a big expense. Production costs (seed, fertilizer, pesticide, labour, machine rental, irrigation fees) and land amortization or rental fee took a large chunk of the harvest. "Take-home" grain was not enough for the family until the next harvest. Rice had to be bought from the market.

Meanwhile, population increased. Rural poverty accelerated migration to the cities. But unemployment soon took its toll. Widespread urban poverty became a devilish twin of rural poverty. As Meadows et al. (1974) observed, where economic inequality already exists, the Green Revolution tends to cause widening inequality.

Ecological aspects

There are now only 4-5 HYVs widely planted in the country. The farmer has to buy certified seeds from seed producers. Loss of indigenous seed means erosion of genes that have been adapted to local environments for centuries. Farmers' seeds constitute a natural seed bank for breeding and crop improvement – a patrimony that a people should protect.

Breeding strategies for semi-dwarf rice have been known to result in the narrowing of genetic base (Richharia, 1988). Some HYVs already in widescale production in the Philippines have succumbed to tungro virus and other pests.

Extensive use of pesticides caused disappearance of beneficial insects, while certain pests become resistant to commonly used pesticides. Farmers also noticed the disappearance of fishes, frogs and snails.

Listen to the farmer

The glaring spread of rural poverty prompted some non-governmental organizations (NGOs) to start consultations with small farmers about the impact of HYVs and other concerns in rice farming. Talks were then organized on a regional level (Luzon, Visayas, Mindanao), followed by a national convention in mid-1985.

In May 1985 a small multi-disciplinary group of professors and researchers at the University of the Philippines at Los Baños (UPLB) started weekly meetings on issues about HYVs and rice farmers. This group, known as MSF (Multi-Sectoral Forum), joined as observers in the national convention held on the UPLB campus.

For three days, farmers discussed their experiences with HYVs and their problems with government policies. It became clear that farmers should have been consulted before embarking on nationwide HYV production. They should have been listened to when increases in rice yield were not reflected in their real net income.

Certainly, farmer wanted higher rice yields but not by accumulating unpaid loans for inputs and poisoning the streams and fields. They wanted a wide choice of rice varieties to plant. They needed low-external-input technologies relevant to local resources. Loans and technical assistance should not have been tied up only with HYVs. This was seen to guarantee profits to foreign-owned corporations at the expense of the farmers.

The message was loud and clear. But was it heard? Yes, the NGOs and MSF listened, but the farmer's principal targets were the policy makers to whom their problems were presented in a public forum at the end of the convention.

Farmer-NGO-researcher partnership

Within a year after the convention, a farmer-NGO-researcher partnership was formed. A project whit the name of MASIPAG was born to initiate farmer-based research and training for sustainable agriculture. This means that field studies of problems identified by farmers are worked out by them together with NGOs and researchers (MSF). Similarly, farmer-based training begins with what farmers want to learn. What they need to learn from the researchers' perspective comes second.

The main project components are:

- CIMME (Collection of rice cultivars, Identification, Multiplication, Maintenance and Evaluation)
- Breeding (hybridization of farmers' selections)
- APM (Alternative Pest Management)
- Biofertilizer usage (crop residues, local organic resources, green manures, microbial inoculants)
- Diversified farming (cropping systems, crop-livestock-poultry systems)
- Training (includes training needs related to the above components, plus other specific problems of farmers)
- PBMES (Project Benefit Monitoring and Evaluation System).

Cropping for components 1, 2 and 3 is being done without chemical fertilizers or pesticides. Rice straw is returned to the fields to decay before the next cropping. Biofertilizers are used for selected rice cultivars and other crops.

A 3 ha research station was set up in the province of Nueva Ecija (Central Luzon) in mid-1986. The area is an irrigated lowland on a flat alluvial plain. It has a warm climate with distinct wet and dry seasons (3-4 wet months). After 1987 trial farms were started in the provinces of Quezon, Aurora and Camarines Sur. These are located on irrigated ridges or foot-slopes of mountains and have a less warm but more humid climate (5-8 wet months) than the central station.

Research highlights

From 1986-1988, 140 rice cultivars were collected from various parts of the country. These are being purified and characterized in field plots. Cultivars evaluated by farmers also included 21 advanced lines from UPLB Department of Agronomy.

As of 1988, farmers' top 11 selections in field plots included 4 traditional and 5 improved varieties and 2 advanced lines.

At least 10 farmers learned and practised the art of crossbreeding. The parental materials are their own selections for specific characters and not necessarily from the 11 top selections. Selections for F3 and F4 plantings are currently being made. These originally came from 33 single-crosses.

The first step toward low-external-input farming is the plow-down of decayed rice straw, with no chemical fertilizer application. In 1988 three traditional varieties yielded about 4.5-6.5 tons/ha and the improved varieties (including IRRI HYVs) yielded 3-5 tons/ha.

As biofertilizer, inoculation of the soil with N-fixing actinomycete, Frankia, was introduced. Initial results indicate positive responses, but they appear to vary with the cultivar. Hence, Frankia x cultivar experiments are currently being conducted. This is the first time that Frankia is being studied as biofertilizer.

Within this farmer-based research and training project, farmers have developed their own crosses from their own selection of parental materials for the first time in the history of Philippine agriculture. The results of farmer-NGO-researcher cooperation are also leading to good production without fertilizers and pesticides. In 1988 the top traditional rice varieties were already yielding as high as or higher than improved varieties resulting from conventional breeding. ■

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MASIPAG: a farmer-scientist partnership

In 1986 the first MASIPAG centre for farmer-scientist cooperation for agricultural science development was established in Jaen, Nueva Ecija, The Philippines. Farmers and scientists are working together in collecting and maintaining local rice varieties, and in developing improved low-external-input techniques of integrated pest management, diversified cropping, integration of livestock and aquaculture, and green manuring.

This approach to farmer-based research and training, which evolved out of farmers' and concerned scientists' reaction to laboratory-bound science, is also described in Joe Medina's paper, MASIPAG: Farmer-scientist partnership in rice project, written for the ILEIA Workshop on Operational Approaches for **Participatory Technology Development** in Sustainable Agriculture (see 1989 proceedings, pp. 53-54) as well as in a book by Rolando B. Modina and A.R. Ridao (1987), **IRRI Rice: The Miracle That Never Was**, ACES Foundation, 12 11th Avenue, Murphy, Cubao, Quezon City, The Philippines.

Village-based seed production

The concept of village-based seed banks is central if peasants are to have better access to a variety of inexpensive quality seeds, be they hybrid, composite or landraces. Esbern Friis-Hansen describes the role of seeds in African peasant societies, and gives ideas on village-based seed production in Tanzania and the decentralized seed multiplication scheme in Malawi.

Esbern Friis-Hansen

The debate about rural development and the situation in Africa has focused to a large extent on the characteristics of and relationship between the state and peasantry, often with a theoretical point of departure. In recent years, much of the discussion has centred on analyzing product markets and exchange relationships. Less attention has been given to the role played by the state in securing a market for agricultural inputs. The use of external agricultural inputs by peasants in Africa has increased drastically over the last decade, although the quantities used per hectare are still far from those reached in the developing countries of Asia and Latin America. Despite the low quantities used, a large proportion of African peasants are dependent on seasonal use of external inputs on at least some of their fields. For example, in 1986 the adoption rate for improved maize in Africa was estimated at 25% (CIMMYT, 1987).

Important differences

There are important differences between agricultural seeds and other external inputs, e.g. mineral fertilizers and pesticides. Most obviously, peasants have the choice of self-sufficiency in seed through annual retention from harvest. Such self-sufficiency is less obvious for other seasonal inputs, as production pressures on resources through annual monocropping lead to declining soil fertility and build-up of pests. Agricultural seeds are the basis for agricultural production and crucially important to farmers. Seed retention as practised by African peasants is a simple form of plant breeding. In this way, local composite varieties are maintained and adapted to the local environment, farm practices and culturally specific end-uses, but the yield potential will eventually be reduced. Use of improved seeds has the potential of significantly increasing agricultural yields for smallholder farmers. Intensification is needed by farmers, as population pressure and commercialization force them to intensify their farming systems. The ''Green Revolution'' was successful in developing improved varieties of self-pollinating crops such as rice and wheat, while less attention was given by plant breeders to open-pollinated crops such as maize, millet and sorghum, which are the major stable crops in sub-Saharan Africa (CIMMYT, 1987). Even less breeding work has been done on vegetatively propagated crops (by cuttings, roots or tubers) such as cassava, yams and sweet potatoes, which are important in terms of food security.

In Vwawa, southwestern highland Tanzania, maize cobs are being fetched from the field to the homestead. Are the new hybrid maize varieties a source of new wealth, or do they bring greater risks? (Photo: Kees Manintveld)

Much research still needed

While plant breeding in the past have suffered many set-backs in meeting the needs of smallholders, this situation is being improved today through re-orientation of agricultural research. What remains is to transform the results from research stations into increased production to the benefit of the smallholders. Less than a third of the African countries surveyed by FAO in 1984-1985 has established seed production and distribution facilities for major crops (FAO, 1987). Moreover, in countries where seed industries are well established, these concentrate on major commercial crops at the expense of commercially minor crops, e.g. small grains or legumes. These are crops which are nevertheless important for the peasant household food security and for possibilities of sustainable farming. There is a large body of knowledge on technical matters concerning seed production, but much research in still needed to understand the relative influence of performance of factors such as price sensitivity, centralization of production, or farmers' attitudes to alternative sources of seed and seed types (Hawksley, 1989).

Village-based seed production

Tanzania has today a serious deficit in production of certified maize seed. Less than a third of the actual demand for hybrid seed is met by TANSEED. The existing seed industry is incapable of supplying the peasants with sufficient and timely delivery of improved maize seed. Moreover, the seeds available are hybrid biased and too expensive. A competitive composite maize variety suitable for the highlands, from which the farmer can retain seed for 4-7 years without unacceptable reduction in potential yield, was released by plant breeders in 1987. Production has still not been taken up by the seed industry.

Decentralizing

The following is an outline of a possible decentralized seed production which may, in time, increase the availability of different seed varieties to peasants. The concept of village seed production is based on decentralized and technologically appropriate modes of production as a supplement to, or even alternative, to rehabilitating the existing donor-financed capital intensive and centralized mode of production. Village-based seed production could come about by establishing small-scale farms which can produce sufficient improved seeds to satisfy the needs of the local community. Such farms could be managed privately by groups of better-off farmers or under community control. The decentralized seed farms could be supplied annually with foundation seed from the research stations/seed industry, and could concentrate their activities on seed multiplication and marketing to the community. During the growing season, the village-based seed farms should receive extension advise from decentralized seed inspection units. When they have become familiar with the techniques, the farmers could take over the maintenance breeding of the improved composites and thus become self-sufficient with foundation seed. This requires that the farmers are trained in maintaining the stability of the plant population and in avoiding genetic erosion from cross-pollination. The needed improvements to the existing seed selection techniques, retention through mass selection, could be taught to farmers within one week of training.

A sustainable model

It requires good husbandry to achieve high yields of quality seed, but this does not necessarily imply tractor mechanization or need for capital-intensive equipment. A village-based seed farm could depend on draught-oxen for ploughing, weeding and local transport. Crop processing, dressing seeds with fungicides and packing in bags can be done at the village level, using already known labour-intensive technologies. Improved composite maize seed could be produced and consumed within the same local area, thus drastically reducing the transport costs, which today make up the major part of the present seed price. At 1988 prices, the estimated production cost of improved composite maize by village-based seed farms is 10 times less than the consumer price of hybrid seed (Friis-Hansen, 1988). Village-based seed farms could constitute a sustainable model for securing sufficient and stable supplies of improved seeds.

Malawi

In the early 1980s the National Seed Company produced sufficient seed for maize and tobacco, while production of improved seeds for wheat, rice and groundnut were in deficit. In an attempt to solve the problem, the government initiated a smallholder seed multiplication scheme (SSMS). The following will briefly outline the concepts and experiences from this for groundnut.

The basic goal of the SSMS was to decentralize seed production so each Agricultural Development Division (ADD) would be self-sufficient with improved seed of acceptable quality. The concept is that ADD extension staff select and supervise the smallholder farmers participating in seed multiplication. Each smallholder is supplied foundation seed sufficient for cultivating 0.4 ha. During the season, a decentralized seed control unit inspects the crop and, after harvest, accepts or reject the crop as seed. The accepted crop is bought from the farmers at a price slightly above that of the official marketing board.

Economically viable solution

After SSMS proved to be workable in two ADDs during the 1984/85 season, it was expanded to all four ADDs in 1985/86. Due to organizational problems the SSMS was repeated on a reduced scale in the 1986/87 season. As indicated in the table, smallholders are capable of producing improved seed of acceptable quality. Moreover, the fact that all seed produced by SSMS has been sold shows that the scheme has been filling a real demand for seed. The SSMS has experienced a number of problems, largely due to the time and costs involved in carrying out the various activities for the numerous smallholder seed producers. The SSMS is seen as a solution in the medium term only. The centralized seed industry will be, in the long term, the most economically viable solution. ■

SSMS groundnut seed production 1984/85, 1985/86 and 1986/87

	1984/85	1985/86	1986/87
Numbers of farmers passed	341	3714	1902
Number of farmers failed	22	323	188
Area of crop passes (ha)	139	1486	824
Seed production (ton)	95	1083	594
Average yield (ton/ha)	0.7	0.7	0.7

Source: Extracted from Sibale and Mtambo, 1989.

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Grass roots alternatives for conserving genetic diversity

The role of biotechnology and industrial pressures to patent genetic resources for agriculture is increasing. There is a growing concern that the diversity needed to adjust to changing circumstances in the future will be lost. ICDA sees hope for reversing genetic erosion by supporting co-operation of farmers and NGOs in community-based conservation work.

Renée Vellvé

A large share of the earth's genetic diversity has been brought down to us through Third World farmers' indigenous knowledge and careful labour. Without the wealth of genetic resources found in the tropics and subtropics, world food production could not meet the challenge of permanently changing ecological forces and societal needs. The genes found in farmers' landraces and wild and weedy plants in the South provide breeders with an arsenal of useful traits such as disease resistance, cold and drought tolerance and nutritional qualities. But, that diversity is being lost through the on-going spread of so-called high-yielding or modern varieties during the Green Revolution as well as through deforestation.

The knowledge and careful labour of women farmers has maintained much of the diversity in traditional cropping. Here, a woman in Botswana selects sorghum seed from a mixed plot of sorghum, millet and maize. (Photo: Henk de Zeeuw)

Genetic suicide

One of the highest uncalculated losses resulting from the massive distribution of the new crop varieties (essentially rice, maize and wheat) was the replacement of farmers' plant breeds and wild relatives that contain unique genetic combinations with highly uniform varieties that need large doses of fertilizers and pesticides to compensate for their inherent genetic weaknesses.

The dangers associated with such a genetically suicidal production system became painfully clear in the USA when, in 1971, 15% of the Corn Belt's harvest was wiped out by a lone fungus causing corn leaf blight. Susceptibility to the fungus was traced to a male sterility trait upon which most of the crop breed was based. In response to the crisis, breeders rushed to their precious reserves and selected new maize lines. However, the lesson may have been short-lived. It is rumoured today that 50% of the US

Zimbabwe Seeds Action Network (ZSAN)

At present, the communal farmers make up over 70% of the farming community. The majority reside in marginal areas with very little potential of agricultural production and are very marginalized in terms of resources. At present, most communal farmers plant hybrid seeds. This benefits the seed companies in that farmers must return to the market every year to buy seed. Though the Green Revolution has benefitted resourceful farmers in high potential areas, the same cannot be said for the majority of small farmers confined to marginal areas. This is a.o. because, for household requirements, some of the improved varieties do not meet the farmers' expectations in terms of storage quality, palatability and end-use qualities. ZSAN, composed of 4 NGOs, is concerned about the food security status for the majority of communal farmers in marginal areas and about the continued loss of genetic diversity. Activities of the Indigenous Seeds Project encompass the following aspects:

- characterization, collection and safe storage of available indigenous seeds of food plants;
- on-farm agronomic test trials of the different crop varieties in comparison to the recommended hybrid/improved varieties;
- seed multiplication and distribution of better performing varieties (farmers' perceptions mainly used to measure performance and acceptability);
- nutritional analysis to determine food value contained in the grains.

The identification, collection and storage component of the programme has enabled ENDA to develop an inventory of the various food plants (maize 25, sorghum 30, pearl millet 29, finger millet 18 and 14 groundnut landraces have been collected so far) to guarantee continued existence of the materials. The indigenous seeds supply system is envisaged to offer farmers a cheaper, more reliable and easily accessible source of seeds and reduce the farmers' dependency on annually purchased seed. For more information, contact: ENDA, ZSAN, Elliot Tembo and Simon Mushita, P.O. Box 3492, Harare, Zimbabwe.

maize crop is currently based on only two inbred lines. The price for such vulnerability can perhaps be borne by some of the better-off US farmers, but for Third World farmers it can be ruinous.

Informal systems

Until now, the international community – dominated by the industrialized countries – has responded to this problem by setting up high-tech gene banks. These cold storage facilities are situated mainly in developed countries and within the walls of the International Agricultural Research Centres. The shortcomings associated with these systems are well known and documented (e.g. Mooney, 1983; Plucknett, 1987). They include chronic underfunding, lack of trained personnel, electric power failures, genetic drift of stored samples, loss of germination qualities, long delays in characterizing and evaluating the material, and restrictive practices in germplasm distribution, all of which make the future and sustainability of world food production very insecure. At the same time, legal provisions for monopoly rights over 'improved' plant varieties have contributed to increased genetic uniformity, resulting in the vulnerabilities and crop losses described above. Non-governmental organizations (NGOs) committed to the survival of the small farmers have been struggling against these trends and institutions for many years now, and their efforts are slowly starting to bear fruit. Where electrically-generated cold storage systems once dominated the minds of conservationists and plant breeders, increasing attention is being paid to the viability of alternative, informal systems of conserving genetic diversity.

Possibly promising alternatives

On-site activities involving the safeguarding, improvement and use of indigenous genetic resources in the Third World are gaining popularity, both in NGO circles as well as among policy-makers, as a more farmer-oriented and sustainable approach to conservation and seed production. Such projects are so diverse, multifaceted and tied in with local cultures that it is often hard to generalize about their origins, structures and goals. Many were born within the framework of local smallholder support programmes. Some are linked to governmental structures: others are totally independent. Some projects provide for the establishment of seed banks, seed exchange, breeding, etc. to support alternative farming practices not dependent on chemical inputs. With the support of farmers' networks, these projects can serve as a basis for multiplication of plant seed adapted to local environmental conditions and providing employment and income to rural families. Whether coming from the initiatives of local organizations or Northern-based NGOs, such programmes could become promising alternatives to the formal system of conservation and plant breeding, which is usually not connected with small farmers' needs and participation. ▶

Valley cultivation of traditional rice varieties in India. Pandurang Hegde from India travelled to Nicaragua to exchange experiences in maintaining genetic diversity. (Photo: Pandurang Hegde)

Genetic Resource Programme in Nicaragua

Pandurang Hegde from India has travelled to Nicaragua to exchange experiences on genetic resources. Nicaragua had to start its genetic programme from scratch.

The initial emphasis to collect indigenous seeds was mainly on the crops like maize, beans and sweet potatoes. These crops formed the staple diet of people and there was an urgent need to conserve the rich diversity among these crops. The genetics programme has three basic areas of work: collection, conservation and evaluation.

350 varieties of corn and 250 varieties of beans in the Pacific and central part of Nicaragua were discovered. In addition to these local varieties, they also identified 'erosion' areas where traditional varieties had disappeared or were disappearing. *In situ* conservation centres for mango, coffee, orange, citrus and sugarcane were also located in specific climatic zones. In contrast to the commercial nature of gene banks, the programme in Nicaragua has set priorities for 'utilization' of these seeds for the benefit of farmers. While evaluating maize varieties they discovered that almost all traditional varieties are susceptible to a viral disease and so it is unavoidable to depend on modern maize varieties. In the case of cassava, the genetics programme has successfully identified a traditional variety that is suitable to Nicaragua.

The genetics programme in Nicaragua has attracted a number of scientists who want to work on traditional seeds. One such scientist from Mexico, an expert on maize, came to Nicaragua to help evolve maize seeds suitable to the country. After hard work and labour he developed maize seed from traditional Mexican varieties which was high- yielding and was not dependent on fertilizers or pesticides. After conducting field trials he released them to the market. To his surprise, these seeds failed. Later, he discovered that another scientist, trained by an international organization, sabotaged the Mexican scientist project through his contacts. This experience shows that the links of international organizations play an important role in pushing a particular hybrid variety developed by them or hindering development of pest-resistant varieties. The scientists trained by these organizations are brain-washed to propagate hybrids that help the multinational companies. ▶

Further action

Attention to the informal system of conserving genetic resources has only begun. Further action is needed to achieve more widespread viability of this approach. At the international level, NGOs are lobbying for a structure to secure funding for community-based conservation activities through the International Fund for Plant Genetic Resources administered by the FAO. Established in 1987, the Fund is designed to channel support to germplasm conservation and enhancement projects in the developing countries. Organizations within the Seeds Action Network (SAN) are arguing that funding for such work should be provided by private breeders in the North that collect royalty payments on varieties bred through the use of freely donated Third World germplasm. A minimal 1% levy enforced in the North could provide grassroots projects in the South with some US$150-300 million per year. International committment to farmer-based conservation work could also be pursued through pressuring agencies like UNEP (United National Environment Program) or IUCN (International Union for the Conservation of Nature and Natural Resources) to pay greater attention to the role of rural communities in their biological diversity conventions.

Farmers' rights

Looking at trends in ownership rights over genetic resources, there are two divergent paths. On the one hand, industrialized countries are being pressured by their large drug, chemical and food-processing industries to allow patent protection for higher life forms (plants and animals). Some have capitulated (USA); others are still debating it (EEC). The same type of pressure is being exerted on the more industrialized developing countries (e.g. Brazil, South Korea, Thailand) to provide the same level of patent protection as in the North through bilateral actions (USA) and within the framework of the Uruguay round of GATT negotiations.
On the other hand, the developing countries, their scientists and NGOs are calling for the international legal endorsement of 'farmers' rights' in fora such as the FAO. Farmers' rights of the South, as a counterpart to breeders' rights of the North, would provide compensation to rural communities long involved in maintaining and improving the crop germplasm upon which world agriculture depends. As a non-monopolistic mechanism to reward and stimulate local innovators, farmers' rights should be aggressively promoted in the developing countries as an alternative to the industrial patent system and breeders' rights regime that the North would like to see enacted in the Third World.

Rice paddy being pounded in Nicaragua. But the staple diet is made up of indigenous crops – maize, beans and sweet potatoes – on which the Nicaraguan genetic resource programme is initially concentrating (Photo: Pandurang Hegde)

Community based seed industry

In the long run, however, the most decisive factor in reversing genetic erosion, against these formidable legal trends and the impacts of new technologies, would probably be strengthening the role of community-based conservation programmes. The knowledge of Third World farmers, particularly rural women, as to the use and characteristics of local plants should be maintained, not destroyed. There is also immense scope for action in building up self-reliant local seed industries based on collection, conservation, improvement and multiplication of adapted planting materials. Scientists and NGOs have a useful role to play here in developing practical methodologies for such programmes as well as infrastructure and political support. While such an alternative approach to agricultural development in under tremendous threat and strain from international economic and political pressures, many barriers could be overcome through increased NGO co-operation, information-exchange, networking, lobbying and campaigning. This is, in fact, the philosophy behind the launching of the Seed Action Network. ■

References:
- Agri-News. 1989. **Gene bank or gene morgue?** In: Seedling 6 (5), p. 2. ICDA Seeds Campaign, Barcelona, Spain.
- Mooney, P.R. 1983. **The law of the seed.** Development Dialogue 1983: 1-2. Dag Hammarskjold Centre, Ovre Slottsgatan 2, S-75220 Uppsala, Sweden.
- Plucknett, D. et al. 1987. **Gene banks and the world's food**. Princeton University Press, New Jersey, USA.

ICDA Seeds Campaign is the European contact point for SAN International. For further information, contact: ICDA Seeds Campaign, Apartado 23398, 08080 Barcelona, Spain. ICDA produces the bi-monthly bulletin ''Seedling''. It contains short articles and reviews which are a good source to keep updated on the fast development of the seeds issue and biotechnology. One issue contained information on the economics of biodiversity.

This is always accompanied by benefits and favour for the scientists supporting multinationals.

Conservation of native medicinal plants

Nicaragua has an ambitious programme of Popular Medicine (PM) to conserve the native plants used by common people in curing disease. The project was launched in 1985 and a study of 72 native plants was done on the basis of ethnic botany. They published a booklet that contained information on the use of local plants for medicinal purpose.
The PM concept is rooted locally as the knowledge is derived from ordinary campesinos (peasants) and then a systematic study is conducted. The study involves controlled tests in the hospitals. After verification this knowledge is carried back to the people through health extension workers.

Socio-political background

Nicaragua's experience in the genetic programme brings out the importance of socio-political background for preserving genetic diversity. After the revolution they realized that it is not sufficient to have politicai and ideological independence, but it is also essential to have independence from genetic imperialism to produce food crops on sustainable basis. This fact forced them to give priority to the area of preservation of traditional seeds.
This information is part of a report based on an extensive visit to various genetic programmes in Nicaragua by Pandurang Hegde. Contact him for more information at: Environment Conservation Centre, Hulemalgi Brothers, Chowkimath, SIRSI-581 401, Karnataka, India.

TOP 5

For this Newsletter focussed on genetic diversity, I have chosen a list of five books which provide both theoretical and practical information relevant to conservation of crop genetic resources. International and national efforts to conserve crop genetic diversity typically emphasize *ex situ* methods, whereby seeds or vegetative materials are collected from farmers fields, markets, or natural populations and deposited in gene banks. However, for a variety of social, political, and ecological reasons, *in situ* strategies for crop genetic resource conservation (agroecosystem and rural community-based) can serve as valuable complements or alternatives to more centralized *ex situ* efforts. The implementation of *in situ* conservation strategies for crops and their wild relatives is generally more controversial than that for truly wild plants because of the reciprocal nature of interaction of humans with the evolution of crop and weeds. Therefore specific, local human cultural contexts must be maintained along with the local crop resource bases, components which are avoided when natural parks or biosphere reserves are set up to preserve wild plants.

In addition to my choice of five books, the following are five journal articles which, in my opinion, offer good introductions to dynamics and advantages of *in situ* conservation of crops and their wild relatives: ''Conservation of traditional agroecosystems'' by Margery Oldfield & Janis Alcorn (BioScience 37: 199-208, 1987); *In Situ* conservation of crop genetic resources through maintenance of traditional farming systems'' by Miguel Altieri and myself (Economic Botany 41: 86-96, 1987); ''Genetic diversity and conservation in traditional farming systems'' by Stephen Brush (J. Ethnobiology 6: 151-167, 1986); ''Native crop diversity in Aridoamerica: conservation of regional gene pools'' by Gary Nabhan (Economic Botany 39: 387-399, 1985); and ''The case for *in situ* conservation of crop genetic resources'' by Robert and Christine Prescott-Allen (Nature and Resources 18: 15-20, 1982). As a way to become informed about issues and events (controversies, conferences, policies, and publications) pertaining to conservation of crop diversity, I also recommend a subscription to ''Diversity'', a quarterly journal which reports international news about plant genetic resource-related activities (727 8th St., SE, Washington, DC 20003 USA).

1. E.O. Wilson, editor, Biodiversity (National Academy 'Press, Washington, DC, 1988). This book contains nearly sixty essays on biological diversity, covering topics ranging from descriptions of organisms in various habitats (e.g., tropical forests, urban zones, oceans, islands, agroecosystems) to assessments of the value of resources and their conservation to methods and policies for monitoring and conserving. Only some of the chapters deal directly with agricultural contexts, but I think the comprehensive nature of the book offers a wealth of information that could be applied as well to agriculture.

2. Rural Advancement Fund International, The Community Seed Bank Kit (Rafi, Brandon, Manitoba, Canada and Pittsburgh, North Carolina, USA, 1986). This is a set of pamphlets for NGO workers in Third World countries, providing an overview of issues and strategies for crop conservation and a guideline for creation of rural community based seed banks (revised editions may have been published more recently). It's available in English, French, and Spanish. I like the Kit because it's one of the rare attempts to produce a practical guide on this topic for non-academics. (The Seed Savers' Exchange, RR 3 Box 239, Decora, Iowa, 52101 USA, and Native Seeds/Search, 2509 N. Cambell Ave. 325, Tucson, Arizona, 85719 USA -- both networks of people dedicated to education about and exchange and preservation of heirloom and native crop varieties in the United States or neighboring parts of Mexico -- also provide the public with practical information on seed saving, which could be of value in other areas of the world.)

3. Erich Hoyt, Conserving the Wild Relatives of Crops (IBPGR-International Board of Nature and Natural Resources and WWF-World Wide Fund for Nature, both in Gland, Switzerland, 1988). This is a small booklet, written for the general public as well as governmental and nongovernmental organizations that describes the importance of conservation of crop relatives and methods (*ex situ* and *in situ*) to implement action.

The following two newly published books present chapters on crop genetic resource conservation as one topic among many, but I highly recommend them as general reference books for the theory and practice of an ecological approach to sustainable agriculture and for discussions of limitations or destructive effects of past approaches. Crop diversity in time and space has benefits for modern as well as traditional farming systems.

4. Miguel A. Altieri and Susanna B. Hecht, editors, Agroecolgy and Small Farm Development (CRC Press, Boca Raton, FL, USA, 1989). The chapters cover reviews of small farm development approaches, multiple cropping and other production systems, case studies of traditional farming in diverse environments and research methodologies. Unfortunately, there is a very serious drawback to CRC Press books: their exorbitantly high price!

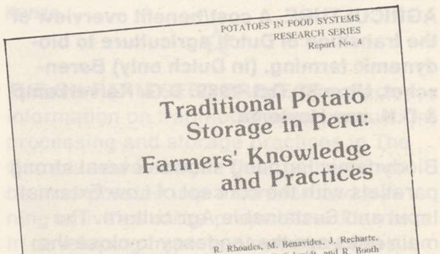
5. C. Ronald Carroll, John H. Vandermeer, Peter M. Rosset, editors, Agroecology (McGraw-Hill Publ., New York, 1990). The four major sections of the book cover: 1) social and ecological effects of technological change in modern and traditional agroecosystems; 2) ecological interactions in agroecosystems (physiological, population, and agroecosystem ecology; diseases, insects, and soil organisms); 3) resource management (natural areas near agricultural sites; nitrogen; pests; nutrition; intercropping; crop and wild plant diversity); and 4) agricultural research in the Third World and in developed countries.

Laura C. Merrick, Research Assistant Professor, Sustainable Agriculture Programm, Dept. of Plant and Soil Sciences, 2 Deering Hall, University of Maine, Orone, ME 04469, USA

Laura Merrick has worked with a variety of international, national, and regional organizations concerned with the collection, conservation, and evaluation of genetic resources of squash in Latin America. She is now a Research Assistant Professor in the Sustainable Agriculture Program at the University of Maine in Orono. In the last several years, she has authored or co-authored a series of articles in the journals Economic Botany and Conservation Biology and book chapters in ''Biodiverstiy'', ''Agroecology'', and ''Agroecology and Small Farm Development'' on the topic of in situ conservation of crop and wild plant diversity in traditional farming systems.

BOOKS

SEED PRODUCTION OF AGRICULTURAL CROPS, written by A. Fenwick Kelly, is a practical guide to the basic requirements for correct production of seed for agricultural crops. The book contains enough fundamental information to enable readers to understand the reasoning behind the management practices discussed (from: Spore No. 18, p. 15).
Order from: Longman House, Burnt Mill, Harlow, Essex CM20 2JE, United Kingdom. ISBN 0582-40410-X. Price: UK pounds 27.42.



TRADITIONAL POTATO STORAGE IN PERU is a detailed and nicely illustrated analysis of farmers' knowledge and practices in potato storage and technology. Robert Rhoades and his colleagues describe and analyze farmers' knowledge from the commercialized coast region to the cooler and more traditional highlands. Stress in the report is placed on farmers' existing practices but against the backdrop of pressure to change.
Contact: International Potato Center (CIP), P.O. Box 5969, Lima, Peru.

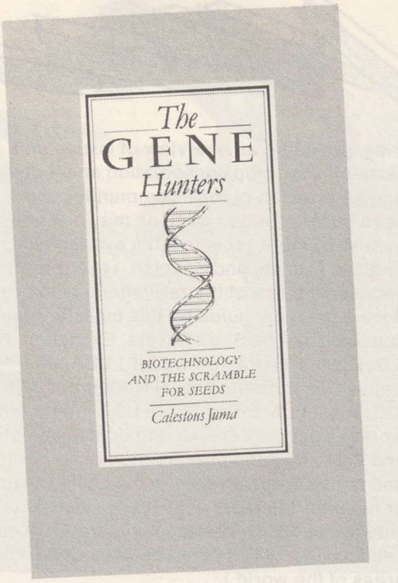
BOOKS

RECURSOS GENETICOS, NUESTRO TESORO OLVIDADO is a book written by Daniel Querol from Lima. In 218 pages, it not only deals with general issues on genetic resources, but also gives valuable practical information: how to set up a small-scale gene bank and how to select genetic resources in the field for improved breeding.

Order from: ICDA, Apartado 23398, 08080 Barcelona, Spain. Price: approximately USD 10.00 (p&p included).

340 ABSTRACTS ON FARMER PARTICIPATORY RESEARCH, a bibliography compiled by Kojo Amanor, appeared as Network Paper No. 5 (June 1989) in the ODI Agricultural Administration (Research and Extension) Network. It includes very good, short descriptions of each book and paper. Several refer to genetic resource management activities (although this is not included in the key words in the subject index). This valuable reference work is in such high demand that it will be reprinted at the end of 1989 as a small book (''Occasional Paper'') .

Order from: Overseas Development Institute, Regent's College, Inner Circle, Regent's Park, London NW1 4NS, United Kingdom. Expected price: UK pound 6.50.



THE GENE HUNTERS, Biotechnology and the Scramble for Seeds is written by Dr. Calestous Juma, of whom you find an article in this Newsletter. The book focuses on the implications of advances in biotechnology and the conservation of genetic resources, for the Third World in general and for Africa in particular. The author argues that the new techniques, unlike earlier technological revolutions, are applicable to small-scale, labour-intensive production and thus offer Africa a significant opportunity to transform its economy.

Order from: ZED Books, 57 Caledonian Road, London N1 9BU, United Kingdom.
Price: UK pounds 29.95 for hardback edition and 8.95 for paperback edition.
Or from ACTS, P.O. Box 45917 Nairobi, Kenya.

IMPROVED LIVELIHOODS, GENETIC DIVERSITY AND FARMER PARTICIPATION is an article by D.M. Maurya and colleagues published in the Experimental Agriculture issue (Vol. 24, Part 3, pp. 311-320) on farmer participatory research. An alternative to centralized plant breeding and seed multiplication is described. The traits of farmers' traditional rice varieties were closely matched with those of breeders' lines, and selected lines were tested by small farmers themselves. This speeds up the process of helping farmers find suitable new seed to increase the diversity and productivity of their own seed mixtures.

Contact: D. M. Maurya, Narendra Dev University of Agriculture and Technology, Narendra Nagar, Kumarganj, Faizabad, India.

BOOK REVIEW

IN SEARCH OF SUSTAINABLE AGRICULTURE. A cost/benefit overview of the transition of Dutch agriculture to biodynamic farming. (In Dutch only) Berenschot, Utrecht, Oct. 1989. D.G. Kalverkamp & D.N. van Hoytema.

Biodynamic Farming shows several strong parallels with the concept of Low External Input and Sustainable Agriculture. The main ones are the tendency to close the nutrient cycles at farm level as much as possible, and the avoidance of synthetic-chemical 'crop protection' and highly soluble mineral fertilizers. Therefore a short discussion of this comparison of the economical and environmental consequences of the transition of Dutch High External Input Agriculture to Biodynamic Farming (BDF) may be relevant for many ILEIA newsletter readers.

Background of Dutch Current Agriculture (DCA)
In the last four decades Dutch agriculture reached high production levels. High imports of cattle feed, for instance, bring the application of cow-dung to the fields to such a level that toxic phenomena occur and the groundwater is becoming unsuitable for human consumption. High levels of N-fertilizers have reduced efficiency to only 29%, the other 71% being emitted into air and groundwater. Important investment in larger scale farming reduced biological diversity. Every 25 years 50% of the farmers can no longer sustain their lives with farming.
The rising costs of environmental damage and of support budgets for production surpluses make the study of transition very relevant, not only for individual farmers, but also for the national society as a whole. The study does not address any possible international consequences.

Results of the study
A highly respected management consultancy bureau compared the actual situation in DCA with extrapolated but well documented results of BD-farms. The document presents the assumptions used in the calculation. The study starts with a comparison of economic aspects at farm level. The realistic gross production levels of BDF are estimated 61% of DCA. This quantity is able to support a Dutch population of 15 million with slightly modified consumption patterns. Labour costs in BDF are 10% higher. Input expenses, however, are 60% lower than in DCA and interest on loans is 15% lower and loans are less important. At farm level, the resulting incomes are negative, which means that they are underpaid as compared to other incomes in Dutch society. BD-farmers are worse off than DCA-farmers with the actual prices. Emissions of nitrogen and phosphorus, pesticides and heavy metals into the environment have also been calculated. BDF does not charge the environment with pesticides and heavy metals at all, because it simply does not use them. In all other qualified environmental effects BDF scores best. The study introduces the ratio 'gross added value: emitted quantities' (guilders: kilogrammes) as a useful indicator of the sustainability of a production activity. The higher the value, the more sustainable the activity. DCA scores only 23, whereas BDF reaches 112 Dfl/kgf. This means that for the Dutch society BDF is about 5 times more sustainable than DCA. The results of the comparison become very interesting when the environmental costs are estimated. BDF has almost no environmental costs. The total costs of counteracting pollution of DCA to the Dutch society is 20% of the gross production value. If environmental costs at national level are taken into account as well, a production system of BDF is estimated to be cheaper than DCA for society as a whole, and more sustainable. To make sustainable farming also more interesting for individual farmers, the authors suggest that the environmental costs could be added to the input costs of DCA, like a levy on N-fertilizers.
This first and prudent step in the Netherlands towards quantifying environmental impact of agricultural production is welcome. It will balance the euphoria of high-external-input agriculture and bring it back to its real potential in environment and in society. The first practical measures indicate already a tendency towards lower external inputs to become more sustainable.

Henk Kieft, ETC Agricultural Sector Coordinator, P.O. Box 64, 3830 AB Leusden, The Netherlands.

NETWORKING

DUCKWEEDS CAN BOOST PRODUCTIVITY OF FOOD CROPS. In Southeast Asia, duckweeds or lemnoids (*Wolffia arrhiza, Spirodella polyrhriza, Lemna paucicostata*) are regarded as major noxious weeds. They grow luxuriantly in stagnant or slightly moving water, forming a green or reddish-green cover over the entire water surface. Some scientists are investigating how these weeds can be used to raise the productivity of food crops.
One method they have tried is to grind the harvested weeds in a mortar and mix the ground material with water to give a 5% extract. The seeds of cereal crops (wheat, rice, maize) are then soaked in this extract for 24 hours and sown in pots with three parts of garden soil and one part cow dung. A second method they have tried is growing duckweed (*Lemna paucicostata*) for four weeks in the waste fluid from leather tanning, then diluting this fluid to 25% and using it to irrigate pulse crops – in this case, lentil plants. Both the soaking of seeds with duckweed extract and the irrigation of plants with diluted tannery waste led to significantly higher production of grains and foliage. The duckweed treatment led to profuse tillering in wheat and rice and branching in lentil, and resulted in a larger number and size of leaves and greater crop sturdiness. The content of protein and minerals in the grains was also higher than in those from non-treated plants. These experiments have been conducted in pots in a greenhouse. Field trials are now underway and initial responses are very encouraging. Throughout Southeast Asia, duckweeds are extremely plentiful local resources which multiply rapidly. They could become a low-cost input for increasing not only the production but also the quality of grain and fodder. The use of these weeds could also be combined with the use of waste from the leather industries so that it, too, could contribute to boosting plant production.

For more details, contact: A. C. Shukla, Biopollution Study Centre, Department of Botany, Christ Church College, Kanpur, India.

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BIOTECHNOLOGY – BOTH SIDES OF THE DISCUSSION. As stated in the Editorial, a lot of discussion is currently going on about whether biotechnology will be a new hope or a false promise. Some research scientists seem to have learned from the failures of the Green Revolution "miracle". Two publications that give biotechnology some "benefit of the doubt" are:

AGRICULTURAL BIOTECHNOLOGY: PROSPECTS FOR THE THIRD WORLD, edited by John Farrington, reviews recent advances in plant and animal biotechnology and potential impacts on Third World agriculture and North-South trade. In the last chapter, Martin Greeley and John Farrington look at future prospects in plant and animal breeding, veterinary products, crop protection, forestry and food industries. They see possibilities that breeding processes can be speeded up to produce plants and animals with specific traits best suited to the varied conditions of small farmers. However, they also point to dangers of biotechnology, e.g. that production of synthetic substitutes for raw materials such as sugar, vegetable oils or vanilla could have a negative impact on farmers. They argue that national agricultural research services in the Third World need strengthening so that they can adapt biotechnological research to serve the majority of small farmers.

Not only the book but also a compact briefing paper, both published in 1989, as well as further information about this subject can be obtained from: ODI, Regent's College, Inner Circle, Regent's Park, London NW1 4NS, United Kingdom.

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MONITOR BIOTECHNOLOGY AND DEVELOPMENT is the title of a new bulletin which assumes that biotechnology has great potential but possibly also major social, economic and ecological effects on the Third World. The bulletin adresses policy-makers in international and national organizations and NGOs.
The pilot issue has articles on: impact of biotechnology in southern Africa, applications for research on cassava, overview of biotechology activities in international agricultural research centres, and economic and political problems of vaccines. It also contains many relevant contacts, literature and addresses!

Available free of charge, so contact: MBD, University of Amsterdam, Oudezijds Achterburgwal 237, 1012 DL Amsterdam, The Netherlands.

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The potential negative impacts of biotechnological advances on small-scale farmers and ways of protecting farmers from them are examined in:

BIOTECHNOLOGY FOR SMALL-SCALE FARMERS is a study presently being carried out by Joske Bunders. It is argued here that present biotechnological research is hardly focussed on the needs and interests of small-scale farmers. Using a new 'interactive bottom-up approach', the attempt is made to compare biotechnological research and conventional solutions according to three main criteria: Are the inputs available to small-scale farmers? Will the innovation improve the quality of life? Will the innovation be destructive to the agro-ecosystem?

Contact Joske Bunders at: Department of Biology and Society, Free University, P.O. Box 7161, 1007 MC Amsterdam, The Netherlands.

☆

THE LAWS OF LIFE, Another Development and the New Biotechnologies, is the title of the special issue of Development Dialogue (1988: 1-2, 350 pp.) by Cary Fowler, Eva Lachkovics, Pat Mooney and Hope Shand. It aims at a 'People-oriented Biotechnology'. It includes a.o. an overview of the basic socioeconomic and technical aspects of the new biosciences; the perspective from the South; protecting United Nations member states from the negative impacts; the impacts on food production, food processing, animal husbandry, human health and the global environment seen from a socioeconomic perspective.

Direct enquiries to the Dag Hammerskjold Foundation, Ovre Slottsgatan 2, S-752 20 Uppsala, Sweden.

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KENGO (Kenya Energy and Environment Organizations) has for many years now been active in collecting and disseminating information on a.o. indigenous knowledge of trees and practical issues of planting trees, tree nurseries and sources of seed. With their recent publication, "Seeds and Genetic Resources in Kenya", they have presented valuable information with the aim of catalyzing a national policy on the conservation and management of genetic resources. It describes indigenous food crops, existing agroforestry programmes and where to get seeds in Kenya. Kengo also produces since June 1989 RESOURCES, a journal devoted to understanding and promoting sustainable use of Africa's natural resources.

Contact: KENGO, P.O. Box 48197, Nairobi, Kenya.

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THE ON-FARM SEED PROJECT collects information on traditional seed production, processing and storage practices in The Gambia and Senegal. Data gathered will be incorporated into extension and training activities of the project to aid farmers in developing improved seed practices. 'Seed Sowers' is the newsletter from the project.

For more information, contact: Valerie Lamont, On-Farm Seed Project, Winrock International, 1611 North Kent Street, Arlington, Virginia 22209, USA. For 'Seed Sowers', contact: Joint PVO/Univ., RDC, Western Carolina Univ., Cullowhee NC 28723, USA.

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A SURVEY OF GOs, NGOs AND SEEDS with names of institutions and their activities has been conducted by Eva Lachkovics of RAFI. It contains information on genetic resource conservation in Kenya, Sudan, Ethiopia, Tanzania, Zambia and Zimbabwe. A similar volume is also available for Asia.

Direct enquiries to Eva Lachkovics, c/o Institute for International Cooperation, Wipplingerstr. 32, A-1010 Vienna, Austria, or to Anita Linnemann, Department of Tropical Crop Science, P.O. Box 341, 6700 AH Wageningen, The Netherlands.

NETWORKING

BIODIVERSITY AND SEED EXCHANGE is dealt with in the last issue (Nov. 1989) of International Ag-Sieve, which includes articles about: Sunnhemp (*Crotolaria ochroleuca*) from Tanzania; *Curcurbita spp.* as fuel sources in Senegal, Niger and Mexico; controlling bilharzia with 'soapberries' (*Phytolacca dodecandra*); Quinoa as a promising grain from South America; tied ridges from Burkina Faso; and a handy list of 11 centres supplying or working with seeds.

Contact: International Ag-Sieve, Rodale Institute, 222 Main St., Emmaus PA 18098, USA.

RARE SEEDS come up in every issue of the newly released news magazine of the KUSA Society, a sustainable agricultural organization (KUSA means 'sacred grass'). Useful facts and practical information about growing, harvesting, storing and using whole grains and other edible seed crops are presented. The first issue highlighted a.o. Einkorn, an ancient wheat variety for temperate harsh environments; barley cultivars; and many books and sources.

For further information, contact: The Kusa Society, P.O. Box 761, Ojai, California, 93023, USA.

TRAINING OF WOMEN IN CONSERVATION TECHNIQUES of Living Natural Resources is the title of a new learning project of Women and Development Programme (Human Resource Development Group) at the Commonwealth Secretariat, targeted at women in Commonwealth African nations. The project welcomes an exchange of experiences on the 'bottom-up' training of women in sustainable agriculture. They will prepare a trainers' preparation guide, trainers' notes, a trainers' resource pack and a pilot two-week training workshop, possibly to be held in Zimbabwe.

Contact: Valerie Shawcross, Marlborough House, Pall Mall, London, SW1Y 5HX, England.

SEEDS AND BIOTECHNOLOGY: New Hope or False Promise for the World's Farmers, is the title of a conference that was held December 2, 1989 in England. It involved farmers, agriculturalists and consumers who are concerned about sustainable world development, and was sponsored by VSO (see page 35), Farmers Link – NEAD and Farmers' Third World Network.

Contact Adria Pittock of VSO for the pre-conference report, papers presented, and other information: Warwickshire World Studies Centre, 32A Bath street, Leamington/Spa, Warwickshire CV31 3AE, England.

ECHO: Educational Concerns for Hunger Organizations Inc. grows and distributes 'underexploited' food plants for seeds. For Third World farmers, ECHO reports on the experiences they gain with planting and harvesting food plants to others. ECHO Development Notes is their publication.

Contact: ECHO, 17430 Durrance Road, North Fort Myers, Florida 33917, USA.

WHERE TO GET SEEDS? Unfortunately, the time was too short for our readers to include reactions to Robert Chamber's call on the back page of ILEIA 3/89. But ILEIA does intend to keep its readers informed about future possibilities and problems in obtaining seeds, so please keep sending in your information. Together with other interested groups, we could work on a more substantial guide about where to get seeds, if such a guide does not yet exist. The contacts we could trace so far that might – to a greater or lesser extent – help you with seeds are the following:

CHECK page 4 and 5 of RODALE's International Ag-Sieve (see above) for information, seeds or catalogues from:

1. **Genetic Resources Information Network**, Antonio Sotomayor-Rios, TARS, P.O. Box 65, Mayaguez, PR 00709, USA.
2. **Seed Saver's Exchange**, Kent Whealy, Rural Route 3, Box 239, Decorah, Iowa 52101, USA.
3. **Native Seeds Search**, Gary Nadhan, 3950 W. New York Drive, Tucson, Arizona 85745, USA.
4. **Sustainable Native Agricultural Center** (corn, beans and squash to Egypt, India, the Yucatan, China). SNAC, P.O. Box 360, Arroyo Hondo, New Mexico 87513, USA.
5. **CIDICCO**, Aptd 3385, Tegucigalpa, Honduras (velvet beans, *Mucuna pruriens*).
6. **Andean Crops Network** (a.o. quinoa), Ing. Humberto Gandarillas, IBTA, Casilla 5783, La Paz, Bolivia.
7. **ILCA (quality legume, browse and grass seed)**, R.G. Griffiths, Head of Seed Unit, P.O. Box 5689, Addis Abeba, Ethiopia.
8. **Asian Vegetables Research and Development Centre** (chinese cabbage, mung bean and soybean), AVDRC Library, P.O. Box 42, Shanhua, Tainan 74199, Taiwan, Republic of China.
9. **FAO** promotes free availability of germ plasm and data on samples via a.o. the Seed and Plant Material Exchange Department, Via Delle Terme di Caracalla, Rome 00100, Italy.
10. **The International Board for Plant Genetic Resources** coordinates and supports information and training efforts and also gives on-site support. IBPGR, address as FAO.
11. **IDRC (an organization that supports research)**, Crops and Animal Production Systems, P.O. Box 101, Tanglin, Singapore.

Thank you, Rodale!

OTHER POSSIBLE SOURCES:

1. **Talavaya Seeds** (non-profit organization, seed exchange and sales, Andean Altiplano and North West of America; beans, maize, quinoa, amaranth, tobacco, chilis and more), P.O. Box 707, Santa Cruz Station, Santa Cruz, New Mexico 87507, USA.
2. **APICA** (shade tolerant leafy forest vegetables, distribution via cuttings, also info bulletins), B.P. 5946, Douala Akwa, Cameroon.
3. **ELC's** comprehensive list of NGOs working on species and genetic resource conservation and distribution, available at cost: P.O. Box 72461, Nairobi, Kenya.
4. G.K. Upawansa, Muruthalawa, Kandy District, Sri Lanka. **Informal plant/seed exchange of Kandyan forest garden species**. Also the address to respond to his article "Ancient methods for modern dilemmas" in ILEIA Newsletter 3/89.

Thanks, Janice Jiggins!

LIST OF SEED DISTRIBUTORS from AGROMISA's booklet on green manures:

1. **Nitrogen Fixing Tree Association** (NFTA), P.O. Box 680, Waimanalo, Hawaii, 96795, USA.
2. **Tree Seed Centre**, Div. of Forest Research, CSIRO, P.O. Box 4008, Victoria Terrace, Canberra 2600, ACT, Australia.
3. **EMBRAPA**, Estrada da Ribeira KM 111, C.P. 3319, 80000 Curitiba PR, Brazil.
4. **Latin American Forest Tree Seed Bank**, CATIE, Turrialba, Costa Rica.
5. **Niftal Project**, Univ. of Hawaii, P.O. Box 0, Paia, Main, Hawaii 96779, USA.
6. **IITA, Genetic Resource Unit**, P.O. Box 5320, Ibadan, Nigeria collects and conserves major African food crops and they are given out on request.

Merci, Agromisa!

HENRY DOUBLEDAY RESEARCH ASSOCIATION will assist groups working in Africa to select multipurpose tree and shrub species (e.g. *Prosopis cineraria*) for their required purposes. They will also provide, free of charge, sufficient seed of tested and guaranteed quality for local evaluation. Seed supplies will be accompanied by full technical and practical details on the cultivation and use.

Contact: Dr. Phil Harris, HDRA, Ryton-on-Dunsmore, Coventry CV8 3LG, England.

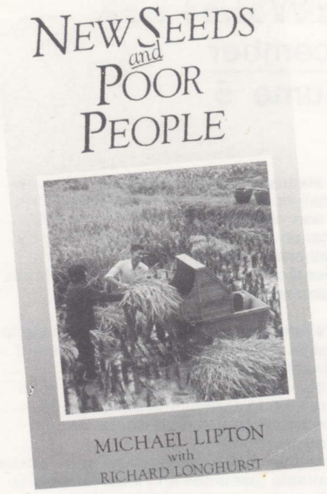
ICRAF has published a multipurpose tree and shrub directory, with lists of suppliers and background information on the species, already in 1986. ICRAF, P.O. Box 30677, Nairobi, Kenya.

COMMERCIAL COMPANIES, a.o.:

1. **The Inland & Foreign Trading Co.**, Block 79A, 04-418/420, Indus Road, Singapore 0316, Singapore (cover crop/pasture seeds, grass seeds, ornamental and flowering trees).
2. **SETROPA Ltd.**, P.O. Box 203, 1400 AE Bussum, The Netherlands (seeds for forestry and environmental conservation).
3. **Timmers & Leyer**, P.O. Box 17, 2100 AA Heemstede, The Netherlands.

Agromisa, in their booklet on green manures (P.O. Box 41, 6700 AB Wageningen, the Netherlands), recommends that you provide the following information when you apply for seeds: main use, months for sowing and planting, altitude of arable land, annual rainfall in mm, the dry months (less than 50 mm), minimum and maximum temperatures, soil pH (acidity) and fertility, seed import permits, special seed varieties, kind of experiment.

BOOKS



NEW SEEDS AND POOR PEOPLE is written by Michael Lipton with the assistance of Richard Longhurst. 'Modern varieties' (MVs) of cereals currently add at least 50 million tons each year to Third World grain output. In Africa and South Asia, poverty continues to increase. How have MVs achieved so much – yet so little? This book pinpoints what has been achieved, what has gone wrong and what to do next. MVs may enlarge cereal stocks, yet the hungry are too poor to buy. The authors conclude that technical breakthroughs alone won't solve deep-rooted social problems. Only new policies and new research priorities – agrotechnical and socioeconomic – will increase the choices, assets and power of the rural poor.

Order from: Academic Division of Unwin Hyman Ltd, 15/17 Broadwick Street, London W1V 1FP, United Kingdom. Price: Dfl. 57.80.

FOOD FROM DRYLAND GARDENS: An Ecological, Nutritional and Social Approach to Small-Scale Household Food Production, written by David A. Cleveland and Daniela Soleri, is both a beginner's guide and a reference on gardens as a development strategy for the desert and savanna regions, especially in the Third World. It tries to bridge the gap between traditional dryland gardening techniques and Western horticultural science. Documented examples of traditional methods are presented together with basic scientific principles.

Order from: Center for People, Food and Environment, 344 South Third Avenue, Tucson, Arizona 85701, USA.

SEEDS FROM THE WORLD is an information pack that explains the origins of the world's cultivated plants and describes the threats to and conservation of the world's plant genetic resources. It also discusses modern plant breeding and the effects of biotechnology on the world's farmers and growers. These issues are illustrated with case studies of wheat, potatoes, tomatoes and tropical orchids. The pack includes samples of seed from which modern varieties have been bred.

Contact: Adria Pittock, Project Manager, Warwick World Studies Centre, 32a Bath Street, Leamington Spa, Warwick CV31 3AE, United Kingdom. Price: UK pounds 3.50.

ILEIA NEWS

PINK FORMS ARE PILING UP!

Thank you very much for the huge amount of pink forms we have been receiving lately. They contain valuable information for our planned register and are therefore of great importance to us. But they are also of great importance to you! If you wish to receive the Newsletter in 1990, we urge you to return the filled-in pink form to us because we plan to delete from the mailing list all readers who did not respond. We are forced to do this, because too often newsletters are sent back to us with the message that our reader has left the address we have in our mailing list. We would therefore very much like to update our files. Although it means a lot of work to us, we sure hope you will bury us in pink forms.

Bea van Burgsteden and Carine Alders.

ILEIA – WORKSHOP AVE LEISA

In 1988 ILEIA organized a workshop on Participatory Technology Development. In 1990, around October, we plan a second workshop. Its main objective will be to Assess the Viability and Effectiveness of Low External Input and Sustainable Agriculture. We greet it: "AVE LEISA".

We hope to find a lot of documented experiences with different LEISA techniques in various ecological zones. Not only from official literature, but even more results from readers' own efforts. How sustainable are your agricultural production methods? We would like to explore the sustainability on two levels: the farm level and the district or national level where the most important policy and financial support decisions are taken. We also wish to explore sustainability from three angles: the human angle, the market-economic angle and the environmental angle. To put it in simple questions, for instance at farm level: Can mankind live a healthy life now as well as in the future? Can farmers' families and others working in the "food chain" gain enough income from it? Is your environment able to support the agricultural activities? To be able to compare LEISA with other agricultural techniques, it would be very useful to try to gather as much as possible quantified data. We might think of production in kilogrammes per hectare, in labour requirements of men and women, income from crops and animals and other products sold, data on pollution or its prevention, efficiency of use of inputs, etc. The result of the workshop is supposed to give an overview of LEISA techniques relevant enough to propose in extension activities, of techniques that need more profound research, and of policy measures that could be advised to policy-makers to enhance more sustainable farming methods.

NOW ILEIA HAS TWO MAIN QUESTIONS TO THE READERS:

1. Please inform us of existing data, or ongoing activities to get them, and of persons and institutions active in this field. We are not only looking for exact data but also for better methods of assessing effectiveness and viability of sustainable agriculture. Any reflections on this item are welcome.

2. We might organize the workshop in the Netherlands, but we are also interested to be informed about potential workshop sites with organizing capacity in countries of readers. Of course we have to select the place reckoning with the majority of potential participants.

Please write on these issues to ILEIA, attn. Henk Kieft. Thank you.

ILEIA NEWSLETTER IN 1990

The first issue will not have a special theme. It will be open for discussions on a.o.: indigenous knowledge and indigenous science; working with indigenous knowledge; alternative ways of crop protection, reactions to 3/89; Genetic Resources, reactions to 4/89; activities of regional LEISA networks. Send us your contributions before February 1, 1990.

THE SECOND ISSUE OF THE ILEIA NEWSLETTER IN 1990 will be a special on Agroforestry. The main emphasis will be put on experiences with on-farm participatory research. How do you do it, which problems do you face and have you got any results? We would like to invite readers to share their experiences with other readers. Especially experiences of research activities of farmers or groups of farmers are very welcome.

Please write to ILEIA, attn. Henk Kieft. The deadline for contributions is 1st April 1990.

Erratum: When writing the caption for the photo on page 35 of the October 1989 issue, we were not in such idyllic surroundings. Instead, we were buried in paper trying to get the issue out on time. So buried, in fact, that we could not even recognize each other any more. From left to right, the correct order of the ILEIA staff in the photo is: Carine Alders, Johan van der Kamp, Bea van Burgsteden, Wim Hiemstra, Coen Reijntjes, Bertus Haverkort.

READERS WRITE

Dear Editors,

I would like to report on some of our experiences concerning erosion of genetic diversity in India and the initiative taken to revive indigenous seeds of rice in South India.

Though government backed Green Revolution technology is pushed hard on farmers, there are certain specific areas in India where people still have confidence and belief in indigenous species of crop seeds and in organic agriculture. For example in high mountains of Chamba district in Hamachal Pradesh (in Himalayan Mountains) people still use the traditional corn varieties instead of government propagated hybrids. The hybrid varieties does not suit to the special mountain climate in Himalayas. The only success is in case of wheat, wherein the hybrid varieties have increased the yields. However, the government has to change the seeds every alternate year to keep up the high yields. However in high Himalayan region people grow only traditional wheat crop as they are more suited to the cold climate.

There is a gradual realization among farmers that the HYV seeds are in fact high input varieties and they are entirely dependent on outside inputs like fertilizers and pesticides. Some farmers have already decided to stop this method of cultivation and they are searching for alternatives. A rice farmer in the foot hills of Himalayas near Dehradun says ''I grow traditional rice on my farm and I use only this for house consumption. I also grow HYV for sale''. A gradual change is occurring among farmers.

A case for traditional varieties

In order to combat the onslaught of genetic erosion a small scale action plan was drawn up this year (1989) to identify existing traditional varieties of rice in Sirsi area, Karnataka, South India. We got enthusiastic response from small farmers as they responded more quickly than big farmers. So far we have been able to trace 15 traditional rice varieties. We hope to generate the interest of farmers in this area towards adoption of traditional varieties by establishing a peoples seed bank.

The advantages of traditional varieties according to the experiences of local farmers a.o. are site specificity; no need to provide high inputs of fertilizers or pesticides, the organic manure is enough to get good yield. Pest resistancy; it grows high and provides good fodder for livestock. Security; taste and weed resistancy. This project of People Seed Bank is a new initiative and the response is encouraging. It is very tough task to fight the overwhelming government propaganda and extension network.

I hope this information is of use to the ILEIA readers and that it encourages them to get practically engaged in the preservation of traditional seeds. We welcome a fruitful exchange of experiences with other NGOs. In many tropical countries, even an existing independent government is not in a position to conserve its genetic diversity. The political and ideological interest of ruling group is in favour of multinational seeds companies. So, even the catastrophes like Bhopal has not initiated any programme to strive for sustainable agricultural systems.

In recent years there is a strong resurgence of maintaining genetic diversity among genetically rich countries. But is should not become a 'museum' to preserve traditional seeds, it should assist the country to evolve a wide genetic base towards sustainable development that helps common people and peasants.

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ILEIA stands for Information Centre for Low-External-Input and Sustainable Agriculture. ILEIA was established in 1982 by the ETC Foundation and has mainly been funded by the Netherlands Ministry of Development Co-operation. The present programme funds are assured till 1994.

ILEIA's long-term objective is to contribute to a situation in which Low-External-Input and Sustainable Agriculture (LEISA) is:

- Widely accepted and adopted as a valid approach to agricultural development, complementary to high-external-input agriculture.
- Recognized as a means to balance locally available resources and local knowledge with modern technologies requiring inputs from elsewhere.
- Valued as a useful perspective in planning and implementing agricultural research, education and extension.
- Developing and consolidating its stock of knowledge and scientific basis.

Low-External-Input and Sustainable Agriculture is agriculture which makes optimal use of locally available natural and human resources (such as climate, landscape, soil, water, vegetation, local crops and animals, labour, local skills and indigenous knowledge) and which is economically feasible, ecologically sound, culturally adapted and socially just. The use of external inputs such as mineral fertilizers, pesticides, hybrid seeds and machinery is not excluded but is seen as complementary to the use of local resources and has to meet the above mentioned criteria of sustainability.

ILEIA is reaching these objectives by the establishment of a documentation centre, the publication of a quarterly newsletter, publication of bibliographies and a register of organizations, international workshops and support to regional networks in Third World countries.

BACK COPIES
of the ILEIA Newsletter are available: (US$5.00)
Vol.3/No.1: **Integrated nutrient supply.**
Vol.3/No.2: **Diversity.**
Vol.3/No.3: **Microclimate management.**
Vol.3/No.4: **Livestock as part of the agroecosystem.**
Vol.4/No.1: **Mountain agriculture.**
Vol.4/No.2: **Towards sustainable agriculture.**
Vol.4/No.3: **Participatory technology development.**
Vol.4/No.4: **Enhancing dryland agriculture:** FSR experiences from Mali, Reduction of risk by diversity, Bitter cassava as a drought resistant crop, Water harvesting, Farmer-based research and extension, Tree planting for soil conservation, The tuna plant.
Vol.5/No.1: **Discussion on sustaining agriculture**
Vol5./No.2: **Intensifying agriculture in humid areas**
Vol.5/No.3: **Farmers' hands on alternatives to chemical pesticides.**

Also available: Proceedings ILEIA Workshop on 'Operational Approaches for **Participatory Technology Development** in Sustainable Agriculture', April 1989. US$ 7.50 (incl. p&p), Third World readers may request a free copy.

**ILEIA,
P.O. Box 64,
3830 AB Leusden,
The Netherlands**