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Farming diversity

LEISA INDIA

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Mixed cropping of cash and food crops
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Dear Readers

We are all in the midst of yet another drought like situation across the country. The examples in this issue highlight the resilience offered by diverse farming systems in terms of sustainable livelihoods from diverse cultures and contexts. While we talk about diversified portfolios in every walk of life, we seem to be caught up in the monoculture syndrome in agriculture. Diversity is fundamental for those who are making a living in fragile eco-systems as well as for those who believe in diversity as the basis for our survival. Hopefully, this issue inspires many more to recognize this approach as both necessary and inevitable.

In retrospect, we feel we are making a tiny effort in spreading awareness on strengthening an alternative movement through 'practice' centric advocacy. We are eternally grateful to all those who write their experiences in the magazine, encourage others to read as well as take pains to share in detail how they are making use of the content in field, training and teaching. Highlighting the indicative diversity of LEISA Knowledge use as shared by our readers, we have compiled a publication 'Inspiring cases' which you can download from our website.

Based on feedback we get, we see a lot of relevance in what we are all doing together in enlarging the basket of options for our farming communities, and sharing experiences of diverse agencies working with them in the field.

We earnestly seek your voluntary financial contributions, either as individuals or as institutions to support the magazine. We shall get back to you individually with regard to modalities.

The Editors

LEISA is about Low-External-Input and Sustainable Agriculture. It is about the technical and social options open to farmers who seek to improve productivity and income in an ecologically sound way. LEISA is about the optimal use of local resources and natural processes and, if necessary, the safe and efficient use of external inputs. It is about the empowerment of male and female farmers and the communities who seek to build their future on the bases of their own knowledge, skills, values, culture and institutions. LEISA is also about participatory methodologies to strengthen the capacity of farmers and other actors, to improve agriculture and adapt it to changing needs and conditions. LEISA seeks to combine indigenous and scientific knowledge and to influence policy formulation to create a conducive environment for its further development. LEISA is a concept, an approach and a political message.

Diversity and efficiency: The elements of ecologically intensive agriculture 11

Fernando Funes-Monzote, Santiago López-Ridaura and Pablo Tittonell

There is plenty to learn from traditional production systems, particularly in terms of productivity, reliability and efficiency, and the role that diversity plays. Some of these lessons are being taken up in Cuba, resulting in a considerable number of farmers enjoying the benefits of mixed farming systems. This is having a positive impact in this country's agricultural production and self-sufficiency: approximately 65% of the food produced and marketed locally nowadays comes from small-scale and diverse farms. On the basis of a thorough evaluation, this article shows some of the issues to consider when designing and managing diverse farming systems.

Small farmers move towards diversification 13

N. Lalitha, J. Diraviam and **Arun Balamatti**

Adding various components on to a farm and integrating them has helped small farmers in Tamil Nadu reap rich harvests. The bio intensive farm models promoted by the Department of Science and Technology were based on agro-ecosystem principles. The diversity of various components increased substantially. Number of crops grown increased, diverse livestock were reared, fodder crops were integrated and the basket of vegetables in the kitchen gardens expanded – and all these have resulted in a sustainable farm production and livelihoods.

Successful tree establishment and the revival of traditional agroforestry 16

Arun K Sharma

In the hot arid environment, trees play an important role. Not only are they directly related to the livelihood of its inhabitants, they also help in improving soil fertility and impact the climate. The Central Arid Zone Research Institute (CAZRI) has been exploring a feasible approach for optimizing tree density in this region, and thus promoting sustainable agroforestry systems. The success of its integrated efforts along with farmers participation were reflected in terms of successful establishment of trees, better monetary returns, environmental improvement and increased resilience of the prevailing system to drought.

Living the sustainable life: Managing a dryland family farm

Aspen Edge 33

Wanting to live a more sustainable life, the author and her family invested their time, energy and enthusiasm in revitalising a farm in southern Spain. As the farm had not been operational for twenty years, they faced many challenges in developing a viable sustainable farming system, whilst restoring and conserving the natural resources. The farm is in the dryland areas, which posed particular challenges. This is their story of creating a management plan, and their experiences in using diversity (such as locally adapted crops and shrubs, using sheep to reverse degradation, and ensuring internal recycling) to contribute to long-term plans.

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Editorial

Diversity expresses itself in many ways. There are diverse landscapes and ecosystems, diverse ways of life, diverse crops and agricultural systems. Traditionally, farming was based on this principle of biodiversity. Small farms were naturally benefiting from the diversity in their natural environment which provided food, fodder, fuel and medicines to the family. In such biodiverse farming systems, farming was self sufficient and farmers were self reliant.

Agro biodiversity started dwindling due to various reasons ranging from inappropriate farming practices to unplanned and unsustainable development activities. Traditional mixed cropping systems have given way to monocultures. Hybrids have taken over local diverse land races. Supportive policies have resulted in indiscriminate use of chemicals ruining soil health. Adding to this are destructive trade practices, poor support prices for local food species, and demographic changes. All these have resulted in imbalanced food production, imbalanced nutrition, and excessive dependence on external markets, resource degradation and finally unsustainable livelihoods.

The crisis is already visible. There are increasing problems for many rural households: migrant labourers return to their homes after losing their jobs, while prices of food, inputs and other commodities continue to increase. This situation underlines the significance of diverse farming systems.

Building farm diversity

There are number of reasons for fostering diversity in agroecosystems. More diverse systems take better advantage of ecological niches. Greater system diversity can also improve stability and resilience. Diverse agroecosystems offer multiple pathways for energy and nutrient cycling; consequently system productivity is not held hostage to the performance vagaries of any particular species. When properly designed, more diverse systems also can reduce problems associated with pests, diseases and weeds and can decrease reliance on external inputs.

Agroecosystem biodiversity can be understood in several different ways. System diversity may be broadened by increasing crop genetic diversity, expanding crop species diversity over space and time, fostering crop-livestock interactions, or improving productivity in favored agricultural areas to protect biologically diverse fragile, marginal, or forested areas from agriculture. Articles in this issue illustrate all the above.

Crop genetic diversity is one of the ways of preserving the crop diversity. Tribal communities and hill communities have been doing over generations based on the traditional wisdom. For instance, Apatanis have inherited and sustained the art of rice cultivation from their forefathers based on traditional wisdom. They cultivate local rice varieties like *Emo, Pyaping, Pyat* and *Mipya*. Diversity is increased by rearing fishes in the rice fields and growing finger millets on bunds between the rice plots.

Farmers have been maintaining crop diversity over space and time. Small farmers who particularly grow for their home consumption have always included a variety of crops on their farms. Practices like mixed cropping, intercropping and crop rotation are being followed to ensure diversity and as a means of maintaining soil health. The small farmers of Central Himalayan region are achieving high level of diversification through rotation of pure crops and through mixed cropping systems. The system has a potential to feed the hill population and conserve natural resources.

Recognising crop-livestock interactions encouraging nutrient recycling, many of the external agencies have been helping farmers design such integrated farms. For example the Department of Science and Technology has been promoting bio intensive farm models based on agro-ecosystem principles. These farms which are "diversity by design" have helped small farmers in sustaining farm production and also their livelihoods (p.13,15). An extensive study in Cuba shows how mixed farms are more productive, more energy-efficient, and show better nutrient management than those specialised in dairy products or a certain crop (p.11).

Biodiversity as a means for sustaining livelihoods has also caught the attention of formal research institutions. For instance, understanding very well that inclusion of trees can help in sustaining crop production in hot arid areas of Rajasthan, CAZRI has been promoting participatory research on tree based farming (p.16).

Small versus big

Ardhendu (p.8) argues that though much of the diversity is lost (or has been handed over to multinational corporations, who use it to breed new hybrids and claim patent rights), whatever remains are in the hands of small and marginal farmers, especially those who live in too dry, too wet or too remote areas and who mainly grow food for themselves. Sarangi (p.22) notes that the Adi tribes of Arunachal Pradesh follow Hill farming system which involves diverse crops and their varieties, medicinal plants, forest species. They are meeting the food, balanced nutrition and health benefits from this farming system.

In the Theme Overview, Coen Reijntjes (p.5) explores the logic of diversity-based small-scale farming in the present global context. He zooms in on the debate about small and diverse farming systems versus big specialised farms. He discusses how the dominant ways of thinking about development are vested in a belief that specialisation and economies of scale are the way to development. Diverse small farms are considered as backward and unproductive. Small farmers either should "modernise" or they should move out of farming, is the logic. The consequences of this logic, for small farmers, for local and national level food security, for biodiversity and for the future of our planet, are enormous.

Small diverse farms are the future

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

In a recent publication*, Miguel Altieri, Professor of Agroecology at the University of California, makes a clear case for diverse small-scale farming systems. He argues that small farms that combine stable and diverse production, that generate and sustain their own inputs and that have favourable energy ratios and good links to markets, comprise an effective approach to achieving food security, income generation, and environmental conservation.

Families that have a range of strategies towards ensuring food security and a stable income, are better prepared to deal with economic and environmental shocks. On-farm biodiversity forms a logical and necessary part of such diverse farming strategies.

It is time to reflect on what small holder farming means to the world.

* For Miguel Altieri's publication, "Small farms as a planetary ecological asset: Five key reasons why we should support the revitalisation of small farms in the global south", see http://www.agroeco.org/doc/smallfarms-ecolasset.pdf. For an interesting discussion on the scale of farming in relation to the food crisis, see the debate on http://www.future-agricultures.org: "Big farms or small farms: how to respond to the food crisis?"

Small-scale farmers: The key to preserving diversity

The small farm sector is of tremendous importance for developing countries. It merits much more support than it has received in recent decades, especially in this time of growing economic and ecological crisis. Research, and the cases in this issue of LEISA Magazine, demonstrates the importance of ecological, economic and social diversity for the improvement of small-scale farming. There are different categories of small farmers, each with their own needs, opportunities and logic. Different strategies are required when supporting them. Recommendations on how to do this have been formulated, but international "crisis managers" still do not listen.

Coen Reijntjes

"In many developing countries underinvestment in the agricultural sector, the dismantling of public support programs and the impacts of trade liberalization have undermined the small farm sector and national food production capacity, leaving these countries even more vulnerable to price volatility. Investment in the agricultural sector has focused largely on export crops to generate foreign exchange, forcing countries to rely on continued low international food prices to meet national food demand. That strategy has failed." (IAASTD, 2009)

Last year's soaring food prices and the food riots which followed have made it clear that long-term neglect of the agricultural sector is no longer an option. Statistics (Hazell, 2007; World Bank, 2008) show that of the 3 billion rural people in the developing world, 2.5 billion are in households involved in agriculture. Of these, 1.5 billion are producing on about 404 million small (less than 2 ha) and marginal (less than 1 ha) farms. In contrast, the number of larger mechanised market-orientated farms in developing countries is only 20 million.

Despite recurrent predictions that small farms will soon disappear, they prove to be remarkably persistent, and the total area of arable land occupied by small farms continues to grow. But small farmers live in relative poverty as most of them earn less than US$ 2 per day, and 400 million live with the constant threat of hunger.

In the policy debate on agriculture, the future of small farms is being challenged. The conventional opinion is that small farms are backward and unproductive. Why should they be supported? History shows that in growing economies, many farmers, especially the youth, leave farming for better paying job opportunities. In many places there are no successors for the ageing farming population. By enhancing this process of economic transition, the rural poor can climb out of poverty and the larger farms get the opportunity to grow in size and income. In times of economic growth, this position may be attractive to governments. But is this the right approach in times of economic and ecological crisis as presently is the case?

Strengths of small farms

In times of economic decline, people stay on the farm or even return to the land as jobs outside agriculture evaporate. From the viewpoint of employment and poverty reduction alone it is important to support small farming. But there are many more reasons.

Besides being largely self-supplying in food, fuel, fibres, fodder, nutrients and herbal medicines, small farms also feed an important part of the urban population. For example, in Latin America, small farms produce 51% of the maize, 77% of the beans, and 61% of the potatoes for domestic consumption (Altieri, 2008).

Pretty and Hine (2001) report on the largest ever study of environmentally and socially responsible farming, covering projects involving 12.6 million farmers in 57 countries. It explores how small farmers can increase output using low-cost, diversity enhancing technologies. Results show that in the 286 sustainable agriculture projects studied, average crop yields have increased by 79% since the early-to-mid 1990s. The evaluation also found that relative yield increases are greatest in rainfed crops at lower yields, indicating greater benefits for poorer farmers. Maize, millet and sorghum, potatoes and legumes all showed yield increases of around 100%.

Several studies have shown that polyculture-based small farms can be more productive than monoculture-based large farms if total output is considered rather than yield from a single crop (Altieri, 2008). On most of the complex and fragile lands, which are remote from markets, only ecologically diverse, (traditional) low external input farming is possible (Jodha, 2001). Communities surrounded by populous small farms have healthier economies than communities surrounded by depopulated large mechanised farms. Strong rural economies based on efficient small farming also allow workers to remain with their families instead of migrating.

By depending more on family labour, recycling and ecological processes, instead of on modern external inputs, mechanisation and fossil energy, diversity-based small farms have fewer costs and are more resource-conserving than conventional large farms. For example, maize yields in traditional Mexican cropping systems are about 1950 kg per hectare. When agrochemicals and mechanisation are used, yields may increase to 8000 kg per hectare but for this higher production an energy equivalent of about 1000 litres fuel per hectare are needed (Pimentel *et al.*, 2007). Energy efficiency is an increasingly important argument in these times when fossil fuel energy will become scarcer and climate change is increasing (to which the use of fossil energy strongly contributes). The strong contribution of conventional agriculture to climate change is not only due to the high use of fossil energy but also to the enormous loss of biomass above and in the soil. By promoting diversity-based small farming, especially agroforestry, high amounts of carbon dioxide can be tied up in soil organic matter, mulch layer and trees. Besides, research in Central America (Holt-Gimenez, 2001) has shown that these farms are more resilient to climate-related hazards like drought, floods and storms, now

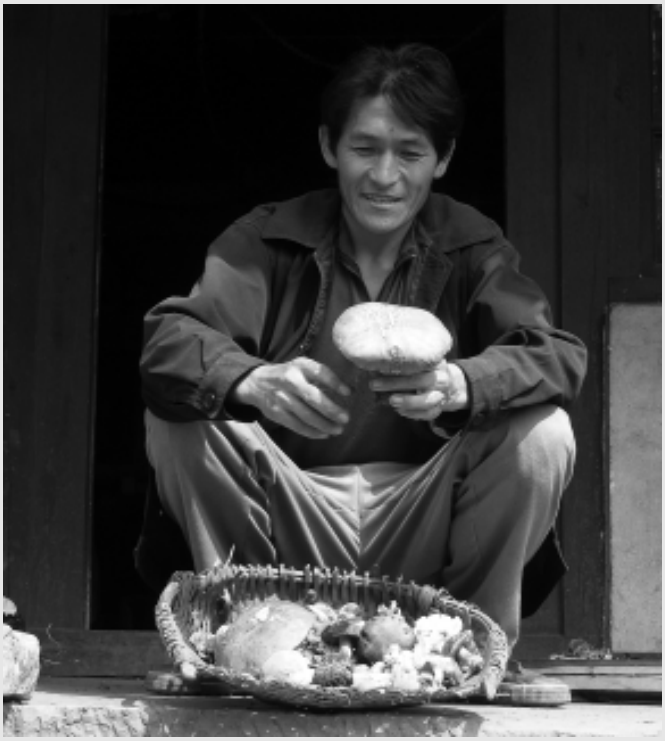

Photo: Karen Hampson

Many subsistence farmers, like this man in Yunnan province, China, also make the most of surrounding natural resources. During the mushroom season he goes into the forests to collect many types of wild mushrooms to sell in urban areas.

occurring more often due to climate change. Hence, it can be concluded that supporting diversity-based small farming will strengthen the economic, social and ecological functions of agriculture.

Different categories of small farmers

There are many categories of small-scale farmers. Small farmers, men and women, are working in all ecological conditions in agriculture-based, transforming and urbanised economies, as full- and part-time farmers, herders or gatherers. Of these, 10 - 15% are traditional farmers (Altieri and Koohafkan, 2008). These farmers have different visions on life and farming and use traditional practices to enhance productivity, resiliency and adaptability. Traditional subsistence agriculture provides promising models for sustainable small farming that promote biodiversity and thrive without agrochemicals.

There are also many small farmers who operate more or less successfully in the market as simple commodity producers or small entrepreneurs. Market-orientated farming has a different logic than traditional farming. Instead of depending on internal ecological mechanisms, farmers producing for markets use external inputs for nutrient, pest and water management, to gain maximum benefit from the advantages of modern fossil energy based technology. On the market they have to compete with other farmers, by increasing efficiency or providing better quality, for example. If unsuccessful they will be marginalised.

More and more farmers producing for markets try to benefit from the growing demand for organic and speciality products to get higher prices. In and around cities many people find employment in urban agriculture based on waste recycling.

The majority of small farmers are "peasants" who also have to gain income from other on- or off-farm activities to satisfy family needs year round. The word "peasant" is not liked by many people because of its negative connotation. But, presently it is increasingly being used as a name of honour by the network of *La Vía Campesina*, among others. Peasant farming can be subsistence or be combined with selling products, both in space or time. Low-cost practices are typically used which can be traditional as well as modern, depending on what is best in their circumstances. In many places, modern technology is not available, too expensive or culturally not acceptable for peasants. Resilience and autonomy are highly valued to reduce risk and vulnerability. Flexible strategies make it possible for peasant farmers to benefit from the market economy in good times and to fall back on subsistence production in bad times.

A differentiated approach is needed

It cannot be assumed, notwithstanding all development efforts, that subsistence, peasant and traditional agriculture soon will belong to the past. As also stated by Madeley et al. (2007), a differentiated approach is needed to support small farmers: "The objective to halve hunger by 2015 will not be achieved unless the needs of the people who live in hunger are recognized and they will receive the right kind of support. A new, comprehensive approach is needed to combat poverty and hunger, which includes subsistence agriculture. Academic studies and donor policies towards small farmers often fail to differentiate between marginal farmers and those who produce regularly for the market. Yet these are two groups of people with very different lives, circumstances and needs. A one-size-fits-all policy for small farmers marginalizes the poorest. Understanding the vulnerabilities and constraints faced by small farmers will help better address their needs".

But what would such a differentiated approach look like? *La Vía Campesina* and the recent IAASTD report have both formulated recommendations on how to support small farmers.

The vision of a peasant organisation

The international peasant movement *La Vía Campesina*, which claims to represent millions of small farmers, formulated its vision on the future of agriculture in 2002. Food sovereignty is the central theme in this vision. The approach is now being supported by many NGOs and CSOs.

By food sovereignty, *La Vía Campesina* means the right of each nation to maintain and develop its own capacity to produce its basic foods, while respecting cultural and productive diversity. The organisation believes that being able to produce food in their own territories, is farmers' right. Food sovereignty is a precondition to genuine food security. Peasants and small farmers should also have direct input into formulating agricultural policies at all levels, they say. Rural women, in particular, must be granted direct and active decision-making on food and rural issues.

When it comes to food prices in domestic and international markets, *La Vía Campesina* is of the opinion that these must be regulated and reflect the true costs of sustainably producing that food. This would ensure that farmer families have adequate incomes.

In general, agricultural research should be resource-oriented and not input-oriented. This research should be farmer- and consumer-driven as opposed to the current industry-driven model. It should start from the local production system, trying to improve it, respecting the objectives of the people that depend on it. When it comes to training and educational programmes, *La Vía Campesina* feels they are nearly exclusively focused on the promotion of industrial agriculture, and do not respect the knowledge of farmers themselves. Education often does not support efforts to maintain or improve the sustainability of family farm based production models.

While many households in Tanzania have one or two goats, some farmers have made goat-rearing into a small business, successfully raising animals to sell the young or the meat in local markets. Photo: Rik Thijssen

The vision of 400 experts

Last year, an unprecedented study was finalised to assess what kind of agricultural science, technologies and policies are needed to address the issues of hunger, poverty and livelihoods in the light of the breakdown of the global ecological system. This study was sponsored by the United Nations, the World Bank and the Global Environmental Facility.

Two of the many issues raised in this report are particularly relevant to mention here. First, to improve food security, the 400 experts who carried out the study suggest to strengthen the small farm sector. Second, to enhance sustainability, development of multifunctional agriculture is seen as a key strategy. The concept of multifunctionality recognises the social, environmental and economic functions of agriculture that is producing not only commodities, but also non-commodities such as environmental services, landscape and cultural heritage. For this, integrated approaches are needed, such as agroecology, integrated natural resource management, organic agriculture, conservation agriculture and agroforestry.

Winds of change, genuine solutions far away

There seem to be important points of agreement between peasant farmers and experts. Does this mean that diversity-based small farming will now be embraced generally? Clearly winds of change are blowing. But, in the vision of *La Vía Campesina* "the major impediment to achieving sustainable ways of producing food is not the lack of appropriate technologies or the lack of knowledge of people working the land. The biggest obstacle is the way in which international and national policies, as well as the agro-industry, are interfering in the food production system. This is forcing farmers to adopt unsustainable methods of production through a model of competition and ongoing industrialisation".

La Vía Campesina delegates at the High Level Meeting on Food Security in Madrid, on 26th and 27th of January 2009, observed that this meeting was dominated by the World Bank, the International Monetary Fund and the World Trade Organisation, as well as by transnational companies such as Monsanto. In their opinion, the meeting did not sufficiently tackle the crucial question of how to solve the dramatic food crisis, but rather focused on how to spend the money. The small farmers only got a few minutes on the floor to give their position. The results: "business as usual", more fertilizer, more hybrid seeds and more agrochemicals for those farmers who can afford to buy.

■

Coen Reijntjes was an editor of LEISA Magazine from 1984 to 2003, and of Compas, Magazine on Endogenous Development, from 2003 to 2008. He is currently helping ILEIA with an assessment of the information generated and disseminated throughout the years.
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Diversified Farming Systems - Learning from past to move into future

Diversity is being lost rapidly both in nature and culture, including agriculture. But, all is not lost yet. Realising the benefits and also as a reliable option in fragile ecosystems, communities are still nurturing diversity. This article highlights issues, available and potential options as well as barriers.

Ardhendu Shekar Chatterjee

During the last 50 years we have been losing diversity at an alarming rate, both in nature and in culture, including agriculture. If it was for clearing greenery for roads and railways in the beginning, in mid 60's it was by promoting monocultures of rice and wheat, large doses of synthetic fertilisers and biocides. As a result, soils which were repositiories of wide range of micro flora and macro fauna, got impoverished and destroyed. As water too got polluted, hundreds of fish, frog, shrimp, crab, snail species etc, living in rice fields and surrounding water bodies, got destroyed. They were rich sources of protein for the rural poor. With advent of mechanization, trees and shrubs in between crop fields were cleared to enable free movement of tractors and power tillers. Gradually, the need for and possibilities of raising strong bullocks and buffaloes affected; local breeds of diverse livestock disappeared, often through active collaboration and sometimes coercion with the state authorities. Imported plants and animal genetic materials, for instance vegetables and fruits, advertised as 'miracles' were expanded through loans and subsidies. With reference to livestock, farmers could not buy indigenous breeds. Exotic short cycle pulpwood species were promoted by forest departments initially for planting on degraded land – gradually were extended to farmland, wetlands and forests, sometimes even replacing multi-utility natural forests. Diversity, at the level of genes, species and ecosystem has therefore threatened by mainstream development; whatever exists today is not because of but inspite of development planners. A national biodiversity action plan is formulated but remains stillborn.

Diversifying cropping system is a goal of the agricultural department but the real message is: 'stop growing less profitable food crops, grow flowers, fruits, spices instead for sale to retail chains or supermarkets in city or even better to export houses'. This diversification has nothing to do with achieving self sufficiency, reducing pollution or erosion of soil and of livelihoods.

Where then, can we find diversity?

Much of the diversity is lost (or has been handed over to multinational corporations, who use it to breed new hybrids and claim patent rights), whatever remains is in the hand of small and marginal farmers, especially those who live in too dry, too wet or too remote areas and who mainly grow food for themselves.

Indigenous tribes living in forested regions in hilly areas of India (mainly north east India, eastern or Western Ghats and in Himalayan midhills) still practice jhum / podu /slash and burn farming. In these farming systems 15-20 or more cereals, legumes, cucurbits, oilseeds and tubers are planted together in patches that are cleared among forested area. Farmers also harvest wild herbs, tubers, mushroom etc. In 3-4 years, trees start to grow back and the plot is abandoned, and a new plot is cleared and planted. These farms are now becoming less productive, because land is scarce and farmers often have to return to the same plot after only 5-6 years (or even less) rather than the 12-15 year rotations observed in the past. Forest authorities have tried to outlaw these people, or replace their farms with monocultures of pineapple, banana, citrus fruits etc. Farmers in India, Nepal, Thailand, Cambodia and Vietnam nurture and grow major and minor millets, rice beans, pigeon pea and cowpeas, dolichos beans, horsegram and kidney bean varieties as well as many varieties of gourds. *Diascorea* yams, jack beans etc from forest are nurtured rather than cultivated. Traditional varieties of upland rice, maize, grain amaranth and buckwheat are often the main food grains cultivated. Many tree leaves are used as food or fodder. These communities hardly use any spices or vegetable oil, food is usually eaten raw, or boiled or roasted.

Diversity is still alive in the Home Gardens, both in the hills and in plains. Home gardens are usually small and are primarily for self consumption. Often, they are managed by women and children based and the choices are based on food preferences rather than market prices. In a home garden, vegetables, decorative plants, culinary and medicinal herbs, fruit and other trees, domestic animals, birds and sometimes bees, frogs and fish etc are raised.

A typical backyard garden in West Bengal would have small fruit trees like guava, lemon, banana, pomello, coconut, arecanut etc. In the drier regions custard apple, jujube, pomegranate are more common. Mango, hog apple, elephant apple, wood apple etc are also found in larger plots. For the fences, thorny or non browsable species are preferred. Flowering plants such as *hibiscus, nycanthes, nerium*; bitter leaf plants such as *vasak, vitex negundo*; thorny cactus etc are commonly planted on fences. Stumps of *erythrina, lannea, coromandelica*, drumstick or moringa are often used as fence post in the moist areas. *Sesbania grandiflora*, arecanut tree etc are planted along fence. Yams or sword beans use them as climbing support. Cultivated or wild variety of ivy gourd, yam beans, hyacinth bean, bitter gourd etc are also used as part of fence. Leafy vegetables commonly planted are, amaranthus (many varieties) basella, sweet or bitter leaf jutes, sour leaf roselle or kenag, curry leaf, drum stick, tavo leaf etc. Many kind of gourd leaves, bean leaves are also eaten but this varies according to region – the highest number of varieties consumed are in Kerala, West Bengal, Assam, North East Indian states. Pumpkins, Melons, Gourds, Brinjals, Tomatoes, Okra / ladies finger, pole and bush beans are preferred vegetables. Taro and sweet potato, elephant foot yam, cocoyam, cassava, *diasco vea* / climbing yams, arrow roots are the preferred tubers in home gardens as most of them are vegetatively propagated. Many indigenous varieties have survived in these courtyard / backyard / home gardens. Chillies, ginger, turmeric, bunching onions, many varieties of basil, mint, lemon grass and other aromatic plants are often grown under the shade of larger trees / shrubs. Many households have a small fish pond, few goats, pigs, chickens, ducks etc (mostly indigenous ones) which are raised mainly on crop residues and household wastes. Larger scale households have cows, buffaloes as well. In peri-urban areas, home gardens have increasingly become monoculture orchards of banana, papaya, limes and lemon, guava, coconut etc or have been overtaken by short cycle plantations of pulp woods such as

eucalyptus, casurina, *acacia auri culoformis* etc. Lately, medicinal plant monocultures, bio-diesel plantations or mono species fruit tree plantations, subsidised by some or other agency are invading the traditional bio-diverse home gardens.

The third area where biodiversity has survived somewhat are small farms in flood prone and drought prone areas, as the external input intensive, market led, hybrid – seed based packages have mostly failed in these disaster / stress prone areas.

In flood prone regions, rice is the main food grain. In rice field, along bunds and canal edges, the only trees seen are babool / *acacia nilotica*, some varieties of *sesbania* and *caesalpania* etc as they can tolerate waterlogged soils. Few palm trees, Jamun or wood apple trees, neem and sissoo trees, rain-trees, soursop shrubs, ficus trees and shrubs may also be present.

The diversity is mainly in aquatic plants, most of which grow voluntarily and are harvested from rice fields or wet lands and their edges as food, fodder or medicinal plants.

In the rice fields of coastal India, 30-40 kinds of edible herbs are found in large quantities; 'Kalmi (*Ipanea*), 'thankuni' (*Centella asiatica*); 'brahmi', 'Sushni', 'kanchire', 'kulekhara', etc are even sold in some town and city markets of West Bengal.

During rainy season all the wetlands and paddy fields get connected, wherever agrichemical use is less, a wide range of fish (mainly insect eating mud fishes), frogs, snails and crabs, shrimps breed in or migrate through the farms. Farmers have developed a wide range of traps (mostly bamboo cages) to harvest this diversity. Some are consumed immediately; some are nurtured in a jar ditch or pond to be consumed later.

Many aquatic weeds such as duckweed, azolla etc are used as duck or pig feed; some are used as mulch or compost material, some as fuel. Water chestnut, water lily, lotus etc. are cultivated in wetlands as food plants and their seeds, stems etc are both consumed locally and sold in nearby markets.

The main plant rice / paddy itself has many varieties, adapted to deep water, saline soil, late rain etc. Rice varieties were also selected for their aroma, shape, texture, taste etc. Even now 150-180 varieties of rice are known / used by small farmers living in Sunderban delta and coastal east midnapore districts of Bengal. Every part of rice plant has many uses or the by-products too are valuables as food or fodder. Rice straw is used as roofing material, to make ropes and paddy storage bins, as winter bedding material for cattle, as substrate for mushroom cultivation, as cattle fodder, as packaging material, as construction material etc. The rice hull is used as fuel, as incubation / insulation material for hatching eggs, as mulch or soil amendment material (especially in charcoal form), as colouring agent in pottery etc. Broken rice and rice bran is used as feed for fish, duck, chicken, pig. Various food items are made from rice powder; puffed rice, popped rice, flattened rice etc are still popular snacks in Bengal. Rice beer is liked by farmers, though the technology used has not developed much as state authorities consider this as illegal / immoral to brew liquor.

In the rainfed / low rainfall regions, maize, sorghum, pearl millet, finger millet have remained as the main food grain (though rice and wheat have entered into many kitchens via public distribution system). Pigeon pea, black gram, chick pea, horse gram in the plains and rice bean in the hills are the main pulses of dry regions grown together or in rotation with cereals. Niger, sesame, safflower, mustard linseed, castor, groundnut etc are the main oilseeds.

Small farmers in Central India and in hilly regions have practiced mixed planting over many centuries. Land is ploughed only once a year and fast maturing, slow maturing and very slow maturing grains, vegetables, spices etc were inter planted. Only a few of these systems have survived as the seeds and associated knowledge has eroded.

In dryland farms and bunds and surroundings the trees that are commonly seen are babuls, flame of the forest, kendu or tendu, Palmyra, date palm etc. More common are thorny shrubs and bushes with inedible leaves such as castor, various cassia plants with milky saps (often poisonous / medicinal), agave etc together with a wide range of grasses.

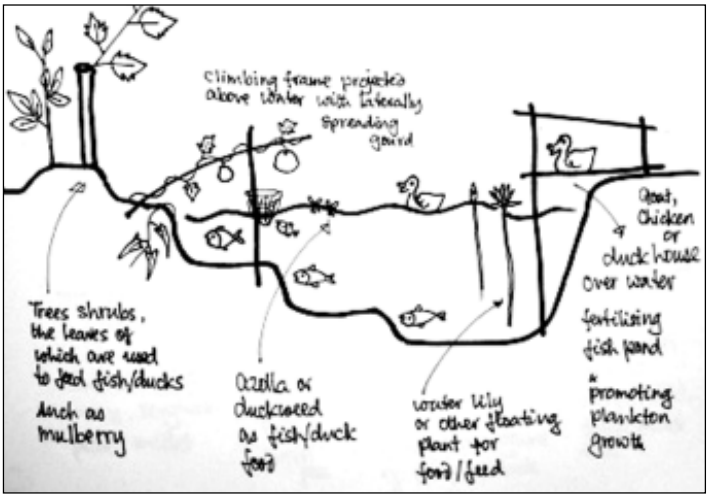
In low rainfall areas, some of the edible weeds are prickly amaranth, lambs quarter, ivy gourd etc – with limited availability. Main strategy of the small holders is to raise animals / birds that can convert low quality vegetation into human food. A wide range of insects and small reptiles are also used as food or feed in the dry regions. Wherever there are forests, roots and tubers, mushrooms, tree leaves, flowers and fruits / seeds supplement the diet especially of low income households.

Our misplaced priorities

In India, we have dramatically increased food supply but have achieved only marginal success in reducing malnourishment, hunger and indebtedness. This is because of (a) common lands, forests, grasslands, wet lands have been degraded or commercialized (b) farmlands have become mono-crop based and soils are eroded / poisoned / exhausted (c) our research has focused on more of the same and high external input reliant hybrid plants and animals (d) indigenous communities have always been seen as 'beneficiaries', 'backward' never as source of knowledge or partners in progress (e) cropping and farming systems are not designed to take advantage of local climate and biodiversity.

Farms of future will have to be *Cost effective* - as farmers will have to deal with open markets, where support prices will not be guaranteed by Government; *Energy efficient* - as fossil fuel prices and electricity charges are likely to keep rising; *Water efficient* - as sources, are drying up and resources are increasingly being privatized; *Productive* - both in forms of land and labour as the prices will keep rising; *Resilient* - yielding a minimum quantity despite soil degradation and climatic variation and regenerative; as many natural ecosystems such as forests, wetlands etc won't be able to perform there ecological functions. To achieve these objectives:

- Farms will need to be multi-storey arrangements, some combination of plants (seasonal / perennial) animals and aquatic life, insects and micro-organisms.
- Farms will need to be well integrated or zero waste. All crop and animal residue will need to be utilized through multi step processes often using a bio-digester, gasifier, fermenter to accelerate nutrient release. Bio-activators, earthworms, algae etc., will also have to play a role.
- Use of renewable water and renewable energy will have to be maximized, use of synthetic fertilisers will have to be reduced drastically and use of synthetic biocides totally stopped. Use of plastics and other persistent organic pollutants also have to be minimized.
- Farms will have to be designed to take advantage of local landform, soil and climate as well as biodiversity and cultural diversity. Top down extension systems and lab to land approach will have to be replaced by participatory action research and participatory technology development / assessment approaches.



- Farmers / gardeners have to be supported to work in mutual cooperation groups especially for soil and water conservation work, social fencing around farms and forests / plantations, seed banks and emergency grain reserve management, water harvesting and water sharing etc.
- Diversity of nature and culture will have to be actively restored and celebrated. Many plants, insects, birds etc that are perceived to be weeds and pests and therefore problems will have to be turned around and studied as possibilities / potentials. Based on these and on underutilised crop residues, animal wastes and by products, non timber forest produce etc, a wide range of micro enterprises can be started to strengthen livelihood options (both through vertical and horizontal expansion.)

Commonly managed seed collections, gram reserves (mostly paddy), revolving funds, small irrigation systems have also been tried with but not in very large scale. Same is true for food and NTFP processing / marketing.

Barriers for scaling up of diversified farming systems

– Those who live close to their land are more likely to succeed. In floodplains, people often live far from their farmlands. Lands are often fragmented.
– Large numbers of farmers are share-croppers and cannot redesign / reshape their farms, even if loans are made available.
– Credit for land shaping, tree planting, integrating small indigenous birds/animals/fish etc are usually not available, especially to small holders. Credit from institutional sources is almost always linked to high-external input bases, high return, high-risk ventures and in most situation insurance is not available or is linked only to commercial crops.
– Unless farmers in the neighbourhood cooperate, it is very difficult for few farmers to change cropping pattern and integrate animals / birds/ fish etc., as they are vulnerable to pollution, poaching etc.

To promote diversified integrated farming, ecological techniques need to be combined with social engineering and backed up by reliable information and training / advisory services, along with credit / insurance and processing / marketing support. Farmers' organisations and civil society organisations concerned about food and livelihood security need to cooperate and collaborate towards this future.

Based on three decades of working experience with diverse communities as trainer / advisor / designer in many parts of India, South Asia and South east Asia in diverse agro-climatic regions and agro-ecosystems, got involved in combining various principles and techniques of diversified farming systems. If we combine the principles and techniques / technologies of traditional home gardens / agro forestry, hill and dryland mixed farming, rice based lowland farming etc., along with modern knowledge and techniques of soil and water conservation, use of biological fertilisers and botanical pest control agents, biogas and producer gas generation, raising of multipurpose trees and shrubs in agro forests, live fences, food forests etc., both food insecurity and poverty can be drastically reduced.

The editors or author may be contacted for few more illustrations of options.

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Highlights of some ideas tried successfully are as follows:

	High rainfall region	Low rainfall region
Home gardens	- Raised beds or deep ditches system. - Floating nurseries and herb gardens. - Multi storey living fences and orchards. - Small multi-utility ditches / ponds	- Roofwater collection, trickle irrigation (subsoil) - Climbing frame with live poles - Drought tolerant trees and shrubs for supplementary feeds (birds and animals) - Strategic food reserves (roots, tubers, edible leaves etc)
Small farms / crop fields	- Rice / duck / Fish farming with azolla - Vermicompost using aquatic weeds and biogas slums - No till potato with deep mulch (mainly in coastal zones) - Relay cropping of legumes, oilseeds, spices and herbs etc.	- Multi step, water harvesting ponds with trees, shrubs on bunds. - Rainfed, row-intercrops of cereals, legumes oilseeds. - Raising vegetables, legumes on field bunds during monsoon - Mushroom culture in winter
Common lands	- Multi species / multilevel good forests (community lands and leased private land) Vegetable growing by groups of women and children	- Community managed multi utility woodlots on roadside, canal bank, pond bank etc - Biodiversity plantation in waste lands, graveyards, cremation grounds etc

Diversity and efficiency: The elements of ecologically intensive agriculture

A six-year study in Cuba has shown that increasing a farm's diversity, for example with a mixed crop-livestock system, increases its overall productivity, energy efficiency and nutrient management. Equally important, it reduces risks, in particular when compared to simplified and homogeneous systems. Mixed systems draw various ideas and lessons from traditional farming systems found in many parts of the world. The Cuban case, at the same time, provides many lessons, especially when regarding the design and management of diverse systems.

Fernando Funes-Monzote, Santiago López-Ridaura and **Pablo Tittonell**

Whether we look at small-scale farming or at large commercial enterprises, designing a sustainable and equitable agricultural system poses continuous challenges. The farming model most commonly promoted throughout the world, based on simple and homogeneous systems, has notoriously failed in terms of sustainability and equity. Where it hasn't failed, but has increased total agricultural production in some countries, it is because this production has been subsidised in one or more ways. Subsidies, whether monetary, or in terms of over-exploitation of resources, absorb the costs of reducing the agroecosystem diversity. At the same time, aspects like environmental pollution, land degradation or rural poverty are disregarded.

Small-scale family farmers have not benefited much from this model. Attempts to improve the performance of small-scale agriculture based on simplified, homogeneous and subsidised systems have often failed due to, among other reasons, limitations of scale. Small-scale farming, therefore, still comprises a diversity of livelihood strategies, diverse land use, management and marketing strategies, the integration of different types of activities (e.g. crop-livestock interactions), intercropping and rotating crops and crop cultivars, or the maintenance of agro-diversity on the farm. Efficient use of the natural, economic and social resources – which goes beyond the efficient use of only a certain input– relies on one or more of these diversification strategies.

There is plenty to learn from small-scale production systems, particularly in terms of the role that diversity plays in making them more productive, reliable and efficient (see Box). Some of these lessons are being taken up in Cuba, where the agricultural sector has been moving in a "different" direction for almost two decades. This change in direction was initiated by the sudden disappearance of subsidies after 1990. After that, a severe energy crisis created the conditions for coming up with a new model of agriculture that relies heavily on agrodiversity. This emerging model may contribute to the design of sustainable systems around the world.

Cuba's path towards diversity

The economic crisis that started in 1990 in Cuba had a big impact on agriculture. Various alternative systems were proposed in order to tackle the difficulties which agricultural production was facing. However, they all showed a common characteristic: they followed an input substitution scheme, in which high-input industrial practices were substituted with organic inputs. These early attempts then led to a new approach, based on the systems seen in Mexico and elsewhere: converting specialised (monoculture) and often centrally-managed farming systems into mixed, diversified (and small-scale) farming systems.

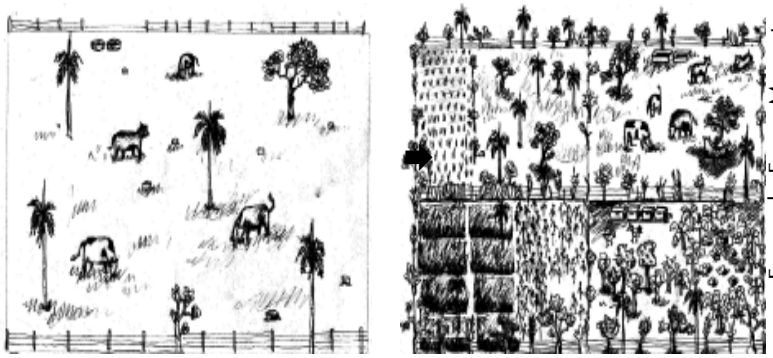
Mixed farming systems are now presented as an effective step towards implementing sustainable practices in Cuba. They aim to maximise the systems' diversity, emphasise soil fertility conservation and management, optimise the use of energy and the locally available resources, and are highly resilient. In short, they are based on three main principles: (a) diversification, by including crops, trees and animal species, (b) integration, considering the dynamic exchange and recycling of energy and nutrients among the different components of each system, and (c) self-sufficiency, referring to the extent to which the system is able to satisfy its own needs without requiring considerable external inputs.

A six-year study followed the transition from "conventional" farming systems to mixed systems, looking at the opportunities for improving productivity while at the same time enhancing sustainability and equity. This started at the Pastures and Forage Research Institute in western Havana, where two prototype mixed farms of one hectare each were established within a 15 ha dairy farm, with 25% and 50% of the total area devoted to crops. The study used different indicators to assess aspects such as biodiversity, productivity, energy use or financial performance. While all measurements showed clear results (a more intensive use of the

Lessons from elsewhere

As in many other countries, policies and development programmes in Mexico have encouraged the simplification of agricultural systems. Nevertheless, diverse farming systems are very common, and they contribute to the livelihood of the rural population and to the country's overall food production. For example, in the highlands of Michoacan, the Purhepecha people have relied on diverse agro-silvo-pastoral schemes for thousands of years. Each household has a diverse herd, including horses, chicken and dual purpose cattle. Livestock is partially fed with crop residues and, in return, manure is used in the fields where crops are grown, to restore soil nutrients and organic matter. The cropping sub-system is normally based on two fields, of about 3 to 4 hectares each, with alternating fallow. In the fallow field, cattle graze maize stubble after harvest during the dry season and, in the cropped field, a mixture of maize varieties, beans and squash are grown together in a mixed cropping pattern known as milpa.

When evaluated, these traditional systems display many advantages, especially when compared to "simplified" systems. They require few external inputs (occasionally some fertilizer and labour for specific tasks such as maize harvest). Although the production of maize, milk, meat and wood might be slightly lower than on specialised farms, resources such as land, labour and inputs are more efficiently used. Nutrient cycles are more efficient, allowing their capture and assimilation by different components of the system and in different forms. Just as important, a diverse system provides the household with various goods for consumption or market, ensuring food self-sufficiency and a reliable and resilient production of cash income in the long term.



Fernando Funes-Monzote

The conversion from a specialised farming system into a mixed farming system follows three principles: diversification (by including crop, tree and animal species), integration (by dynamic exchange and recycling of energy and nutrients among systems components) and the achievement of food self-sufficiency.

available resources through diversified systems contributes to food self-sufficiency and to the efficient production of marketable products), we wanted to see if similar results could be attained on real farms. So we looked at 93 farms, varying in size, proportion of area allocated to arable crops, and in the stage of "conversion" to mixed farming. These farms were found in five different provinces, representing the country's major agro-ecological zones.

A thorough evaluation showed that mixed farms are more productive, more energy-efficient, and manage nutrients better, than farms specialising in dairy products or a certain crop. There were, however, many differences between these cases, mostly depending on the percentage of the area used for crop production in each farm. The farms with the highest proportion of land under crops achieved the highest values of productivity in terms of milk yield per unit forage area, energy output and protein output. Farms with more land under crops demanded three times more human labour, but the overall energy cost of protein production was lower, energy use efficiency was higher, and a more intense use of organic fertilizers was needed. This was mainly due to including crops in systems which were previously pasture-based, which was a precondition to further increases of energy outputs.

Higher proportions of farmland dedicated to cash crops also resulted in higher values for the agrodiversity indicators (such as "diversity of production" or "reforestation index"). Under the conditions of low inputs and high uncertainty in which these farms have to operate, this higher diversity greatly contributed to reducing risk and increasing productivity. Both internal and scarce external resources were used more efficiently in the mixed farms than in the specialised ones, and the diversified farms were more efficient in the use of energy, lowering the energy costs of protein production.

These results showed that when comparing different systems, the issue is not only one of high or low inputs, specialisation or diversification. Equally important is how the specific characteristics of each farming system, the necessary inputs and its agro-diversity are interrelated and managed – in particular, by farmers themselves. In deciding on the proportion of the farm area to be used for crop production, for example, farmers considered factors such as land availability, stocking rate and animal feed balance on the one hand, and soil characteristics, productivity of forages and availability of crop residues, on the other. Market constraints, sales contracts with the state, as well as other socio-economic factors also played a role in deciding the degree of conversion from specialised to diverse farming systems. Managing higher levels of agrodiversity also required design skills and more dynamic decision-making, which led to the empowerment of farmers. In addition, the better allocation of feeds and labour throughout the year contributed to improved resource use efficiency.

Lessons of global relevance

Optimal use of resources for both crop and animal production helps to achieve food self-sufficiency while at the same time yielding marketable products that contribute to household income – without degrading the environment. After only a few years, these highly diverse, heterogeneous and complex small farms are already proving to be substantially more productive and efficient than specialised crop or livestock systems. About 65% of the food produced and marketed locally is grown nowadays by small-scale farmers who cultivate half of the total land in use by agriculture in Cuba.

The many forms and scales of diversity associated with family agriculture play an important role in sustaining rural livelihoods. A quick examination of the many different traditional farming systems shows how agrodiversity is always inherent, and contributes importantly to their sustainability. It guarantees a more efficient use of the local resources, reduces dependence on external inputs while conserving biological resources, and reduces risks. Agrodiversity also plays an important role in the preservation of local knowledge and empowerment of farmers, as diverse agricultural systems are knowledge-intensive and require complex, dynamic and adaptive decision making. These systems need to be thoroughly analysed for their potential to provide services of global relevance, such as carbon sequestration or biodiversity conservation, or for preserving our cultural heritage. Mixed farming systems should be the primary target for protection and subsidies.

But the potential benefits of agrodiversity are not only limited to traditional, smallholder family agriculture. The lessons learnt from the conversion of Cuban agriculture show the opportunities that diversity offers in the design of more sustainable agricultural systems at a much broader scale. The unique position of the Cuban agricultural sector, both nationally and internationally, provides lessons that are highly relevant to the rest of the world. The instability of oil prices, climate change, or the ever-increasing prices of food in the international markets, combined with national awareness of the necessity to substitute food imports for nationally-grown food, opens up a wide spectrum of possibilities for disseminating alternative systems at a nation-wide scale. Diversification, decentralisation, and the movement towards food self-sufficiency, are the response of Cuban agriculture to the current local, international and global context: the very same context that threatens agriculture and food security worldwide today.

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Small farmers move towards diversification

Adding various components on to a farm and integrating them has helped small farmers in Tamil Nadu reap rich harvests. The bio intensive farm models promoted by the Department of Science and Technology and based on agro-ecosystem principles, have resulted in a sustainable farm production and livelihoods.

N. Lalitha, J. Diraviam and **Arun Balamatti**

Small farmers of Perambalur district in Tamil Nadu have been depending on cotton and groundnut crops for their livelihoods. But, increasing costs of production and labour, coupled with severe pest problems, forced them to think of an alternative crop. It was the time when maize was being recognized as a high value crop, primarily for its use as poultry feed. Also, it had less labour requirement than cotton crop. Naturally, farmers in this region started showing interest in maize cultivation.

Farmers initially benefited from growing maize. Owing to its cash generating nature, farmers focused only on maize, neglecting other crops. But, over a period of time, farmers started realizing the problems of continuously growing maize – some directly related to maize cultivation and some were its impacts on other aspects. For example, the yields were reducing while the costs of production shot up. At one point of time, the costs of fertilizer and labour alone accounted to 81% of the production cost. Reduced fodder availability for livestock and absence of vegetables and pulses affecting family nutrition were the other impacts.

Initiating change

AME Foundation, a development agency has been working with the farmers in Perambalur area since 2001. To address the challenges and issues concerning the livelihoods of small farmers, during 2005, in collaboration with The Department of Science and Technology, initiated action oriented and location specific projects in four selected villages, through appropriate technological interventions. The objective was to ensure nutrition and livelihood security for small farmers by developing bio-intensive model farms based on agro ecosystem principles through participatory research.

Five farmers each from Mazhavarayanallur, Vaithayanathapuram, Milaganatham and Perumathurkudikadu villages actively took part in the action research. These farmers, also called as 'experimenting' farmers were selected through a participatory process. The group also consisted of farmers who did not try out the experiments in their fields, but kept constant track of what was going on in the experiment fields. These farmers were the 'observer' farmers. There were about 52 observer farmers in all the four villages. The experimenting farmers together with the observer farmers formed a farmer affinity group in each village.

The farmer groups were taken through a learning process of PTD and FFS for strengthening their capacities on managing natural resources and integrating allied activities with agriculture. The topics for the FFS sessions were planned in consultation with the farmers with an objective of improving the productivity of the present cropping system and also integrating newer components to strengthen the present farming system. FFS sessions provided opportunity to the farmers to learn about natural resource management, which included soil and water conservation, soil fertility management, modified cropping practices and income generation activities.

Besides participating in the learning process, the four groups also formed a federation with a representative from each group. Cross learning and collective action were the major aims of this federation.

Increasing diversity

When the proj**ec**t started, farmers had very basic farm components like crop cultivation, livestock, kitchen garden etc., which lacked diversity within themselves. For example, maize was the only crop grown and fodder sorghum was the only crop and exclusively grown for feeding the livestock. Farmers generally owned only one type of livestock – either cow or goat or hen. Vegetables like gourds and lablab were grown in the kitchen garden, for home consumption. The method of composting was also crude. There

Sunhemp as border crop in maize

were hardly many trees which could generate enough leaf biomass. Only species like Neem and wild moringa were grown on the farm. Each activity was carried out as a separate entity. Thus the present farm system was highly dependent on external inputs, which also was the reason for high production cost.

With the intervention through the programme, the diversity of various components increased substantially. Firstly, the number of crops grown increased. In the first year, intercrops like red gram and sun hemp were introduced in maize crop. During the second year crops like castor, green gram, cymphopogan and Napier grass were included and in the third year, some farmers took up mesta as an intercrop. By the end of three years, there were almost seven new crops included in the cropping system.

In livestock, from a single type of livestock, farmers started rearing a combination of livestock – for eg., cattle & goat; goat & hen; cattle & hen. Subsequently turkey was also promoted. To provide adequate feed to these increased livestock, fodder crops were integrated. Sun hemp and azolla were added to supplement fodder during the first year. Napier grass, Cumbu Napier hybrid, hedge lucerne, lucerne, multicut fodder sorghum, stylo and Calpagonium were few more fodder crops grown in the second year.

In kitchen gardens, the basket of vegetables expanded to include tomato, brinjal, snake gourd, bhendi, bitter gourd and cluster beans.

Trees like Glyricidia, Mango, Sapota, Amla and Tamarind were included on the farm in the first two years and Acacia was added in the third year. These trees provided the fodder for livestock, manurial biomass for farm, as timber, fuel for household and market. Additionally fish rearing, mushroom production and biodigestors for compost making were also included which helped in recycling resources.

Diverse benefits

With increasing crop diversity, farmers realized more maize yield by 25 per cent in the first year and by 15-25 per cent in the second year. But, in the third year owing to dryspell during the critical stages of the crop, the yield of maize got reduced. However, they got additional income from the intercrops to the extent of about Rs.2000-4000 per acre. It was also observed that the effect of drought was more pronounced in maize (observed by reduced yield) as compared with the intercrops. This is because maize crop cannot tolerate moisture stress during flowering and cob maturity stages. Apart from income, legume intercrops also served in meeting the nutrition (protein) requirement of the family.

There was efficient utilization of the resources emerging from increasing farm diversity - green fodder from the farm was fed to the livestock, vegetables from homestead garden was used for household consumption, while, the stalk of the plants served as fuel for the household. The farm wastes and biomass from trees were turned into compost, which went back to the soil again. Introduction of legumes as intercrops helped in building up the fertility of soil.

In the case of livestock, farmers had only one type of livestock such as cow or goat or hen, due to scarcity of fodder. With the availability of fodder through different sources, farmers started rearing two or more types of livestock. Thus, the improvement in fodder availability generated income for the farm families through increased milk yield from 2740 litres to 3480 litres for a pair of milch animals per annum. Through value addition of maize as a cattle feed and inclusion of green fodder, azolla, the purchase of external concentrate feed was reduced.

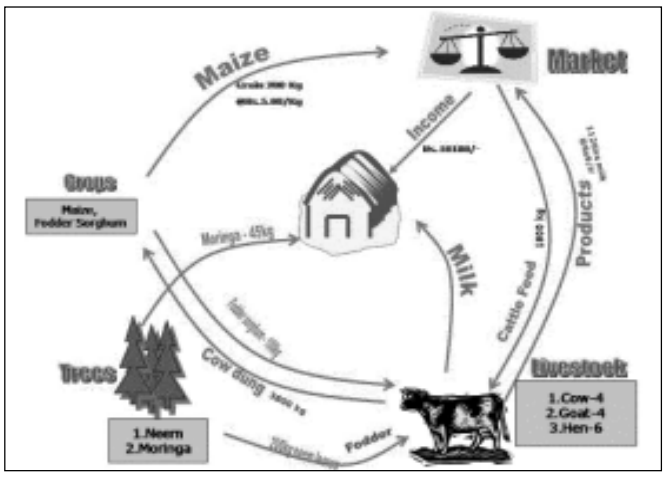

Fig. 1: Resource flow during base year

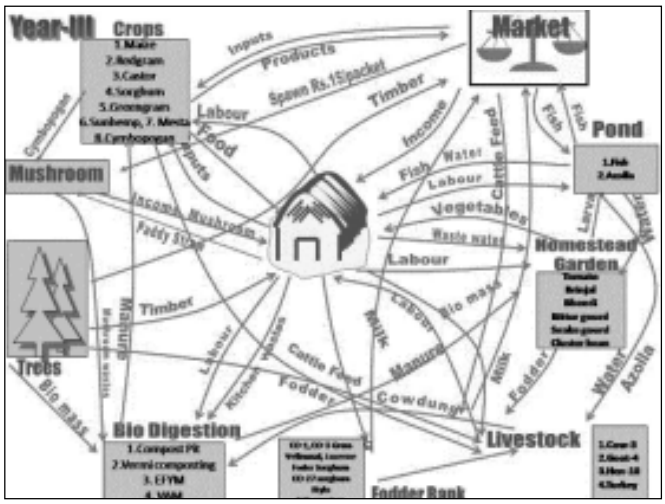

Fig. 2: Resource flow in the year three

Beyond the support

The farmer groups are continuing to practice the intercrop system. They meet regularly to discuss on various farm related issues. They are now keen to learn as group. On their own, they visited farmers' fields in villages of Pudukkottai district to understand the System of Rice Intensification (SRI) method of paddy cultivation. They also visited at Veterinary College & Research Institute, Namakkal district of Tamil Nadu to know more about livestock and fodder production. These groups are now also recognized by National Bank for Agriculture and Rural Development (NABARD) as 'farmers club'. Farmers are now looking at farming with a different perspective with increased confidence levels to face newer challenges.

Acknowledgement

Authors are thankful to Science for Equity, Empowerment and Development (SEED) Division, Department of Science and Technology, Govt of India for funding the project "BIO-FARMS for the livelihood development of Resource poor farmers". They are also grateful to the AMEF team and farmer groups who have made this project a success.

■

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Food sufficiency through diversified farming
A case of a small farmer

Small land holders can be self sustainable. This was proved by Shri. Santu, a small farmer in Gorakhpur, who started making a decent living from farming by increasing the diversity on the farms and integrating one into another.

Anita Singh

Sadhukuti is a small hamlet in Ramchaura village in Campiergunj block of Gorakhpur district. This village is situated on the national highway of Gorakhpur- Sonauli. Farmers in this village have been primarily depending on agriculture for their livelihoods. There are eight households in this hamlet and all of them belong to *sahani* caste. The total village area covers ten acres of land which includes both agricultural land and orchards, majority being mango trees. Monocropping has been the system of cultivation for years. While paddy is grown in the kharif season, wheat with mustard are the rabi crops.

The ill effects of extensive use of inputs was reflected in terms of high production cost, declining incomes and natural resource degradation. These were in turn having impact on the well being of landless, small and marginal farmers. In 1989-90, GEAG, a NGO, started to address the issue of sustainable farming by promoting alternative options. It strongly believed that low input farming or sustainable agriculture is the only and lasting option for sustainable livelihood of the poor and environment conservation. With this belief, it motivated several farmers in the Campiergunj and Sardar Nagar blocks of Gorakhpur district to demonstrate holistic approach of sustainable agriculture. Under this approach, focus was on utilizing their own local resources for development of low cost sustainable agriculture practices. In this approach, small and marginal farmers had to develop as model farmers and demonstrate their agriculture and livelihood sustainability. In December 2004, GEAG started promoting integrated farming systems through its biofarm project in Campiergunj region.

Sri Santu is one of the farmers who benefited from GEAG's interventions. For last three generations, his family has been living in Sadhukuti hamlet. There are ten members in his family. The family primarily depends on agriculture for its livelihood. He has two acres of land with adequate irrigation facility. The type of soil is sandy loam. He has been cultivating wheat and mustard crops in rabi season and paddy crop in kharif season. Being wilt sensitive, plantation of sisso tree and cultivation of pulse crops is not taken up in the area. This has also reflected on the nutritional status of the family. Due to low on-farm employability, Santu sometimes employs himself in transporting people using his bullock cart.

Integrating practices and reaping benefits

Santu along with other farmers in his village actively participated in GEAG's programme. He had curiosity, which motivated him to participate in the planning process. He also started building up his understanding on various conceptual and technical aspects of farming. This renewed understanding helped him to take informed decisions. For example, having understood soil physiology, he started getting his soils tested in every season. He gradually incorporated and integrated various sustainable practices like crop rotation and mixed cropping, integration of leguminous crops, bund plantation, kitchen gardens etc. He also started producing eco-friendly inputs like vermicompost, nadep compost and biopesticides using locally available resources.

Today, diversification is reflected on his farm throughout the year. He cultivates crops of wheat, paddy, oil crop, vegetables along with legumes. Adopting wilt resistant legume varieties has made the availability of pulses for consumption possible, which earlier was a mere dream. Also, planted multipurpose trees like Teak, Sahjan, Neem etc., which yield both fruits and timber wood. Plantation is contributing to water retention capacity of land on one side and checking soil erosion and increasing soil fertility on the other. Other activities include bund plantation and seed production.

Under animal husbandry, along with bullocks, he started rearing buffalo, cow, goats, poultry and fishery. Utilization of organic manure and change in cropping pattern has resulted in remarkable improvement in soil fertility. Consumption of synthetic fertilizer and pesticides has considerably reduced.

Changed cropping cycles and diversification has provided productive employment to all the members of the family. They are now continuously engaged in various activities throughout the year – for eg., irrigation, manuring and pest management, harvesting, selling produces in local market etc.

The adoption of these practices / interventions has not only ensured food security for the family throughout the year but also made nutritious food available to them. His domestic requirement of cereals and vegetables is fulfilled through his own farm production. Additional income is obtained from selling surplus food in local markets.

Other farmers in the village are very much impressed. Motivated by Santu, they are making efforts in terms of adoption of modified agricultural practices. The farmers say that adoption of these practices has helped them to reduce costs of cultivation and earn higher net income.

Santu has also developed himself into a micro entrepreneur. He is involved in activities like selling of vegetable produce in market and development of vegetable nursery in low tunnel system and its marketing. He is also promoting poultry and fishery as additional income generating activities. Honey bee keeping is also fetching additional income.

Presently, he is highly popular among farmers in the district. Farmers who are visiting him are motivated to adopt his ways of success. Thus, Sri Santu proved that small landholders can be self sustainable by adopting integrated sustainable agriculture practices using local resources.

■

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Successful tree establishment and the revival of traditional agroforestry

The article highlights the strength of integrating farmer's involvement in identifying native species, establishment of plant nurseries in the vicinity, timeliness of operations and shared ownership in terms of protection measures. This is an effort of CAZRI in collaboration with local farming communities to revive traditional agro forestry systems in Rajasthan.

Arun K Sharma

Drought is a common phenomenon in Rajasthan and the north west of India. Known as the drylands, this whole region has a very high rainfall variability. More than 30 million hectares are defined as a hot arid zone. During thousands of years, the rural people living in this region have integrated woody perennials into their farming systems, thus evading or minimizing the adverse effects of the frequent droughts. According to the climatic, edaphic and socioeconomic characteristics of the different areas, various suitable drought-hardy and multiple-use tree and shrub species have been selected to grow in the crop fields, constituting extensive agroforestry systems.

The integration of arable crops with trees makes a unique combined protective-productive system that works on the principles of ecology, productivity, economics, and sustainability. These systems are now generally referred to as agroforestry. Because most trees are drought resistant, they are still able to provide fuel, fodder, fruit and other products when and if the crops fail. Thus, trees have a very important place in this region: not only are they directly related to the livelihood of its inhabitants, they also provide an important service of climate moderation in many forms in an otherwise inhospitable environment, supporting soil and water conservation, and even improving soil fertility.

As part of this system, woody components contribute in the form of fuelwood, fodder, minor timber, fruits, and many other edibles. As the production of arable crops in the hot arid zone is a gamble, if not impossible, trees guarantee the provision of many essential products and services when the rains fail. The patterns of integration of the principal native woody species with arable crops/grasses are shown in box.

These extensive agroforestry systems are biologically more complex than other forms of using land for arable farming or forestry. But the region is currently witnessing a very rapid rate of deforestation, and the overexploitation of the already sparse woody vegetation, largely as a result of the pressure exerted by the ever-increasing human and livestock populations. Agroforestry systems seem unable to fulfill the demands of this growing population. This state of affairs puts a question mark on the sustainability of these combined productive-protective systems. In spite of all these drawbacks, the important issues remain the same as in the past, the intricate and harmonious relationship between trees and people of the hot Indian arid zone.

Establishment and degradation of the traditional agroforestry system

As the establishment of trees is not an easy task in the arid zones due to water scarcity and poor soils, farmers developed a simple way of increasing the number of trees in their crop fields: they simply protect and look after the naturally germinated seedlings. This process has several advantages. The species require no additional water, are well adapted to the arid environment and serve many purposes later.

But during the last 4 or 5 decades, due to several reasons, this natural regeneration has not been encouraged nor in any way helped. As a result, the last years have seen fast decreasing tree densities in farm lands. Some of the reasons behind this negative phenomenon are that trees which grow in a haphazard manner in crop fields make it difficult for using tractors or other machinery. In similar ways, trees which grow in wastelands, permanent pastures and fallow lands are also diminishing in numbers, as the lands are increasingly used for growing crops. The intensification of land use seen during the last decades has been done at the cost of tree density. On the other hand, tree plantation programmes also have not been found very successful in this region because of different reasons: the scarcity of water, the preference given to

Trees as the keystone for arid zone life

It has been established that in the hot arid environment, trees play an important role in the amelioration of soil and microclimate. Investigations carried out to establish the positive and negative effects of tree cover on soils have clearly reflected that soils under tree crown cover are a little more acidic than soils without trees. Organic carbon content is also higher under the crown cover of (for example) Prosopis cineraria and Acacia nilotica, than in an open field situation. In general, total nitrogen content and available P2O5 decreases with increasing soil depth; however, these nutrients were maximum under the canopy of P. cineraria and A. nilotica, and minimum under the soils of agricultural fields devoid of trees. In a hot arid environment trees improve soil fertility by:

- increasing additions to the soils with nutrient input through nitrogen fixation, nutrient uptake from deep soil horizons, litter fall and closed nutrient cycling;
- reducing losses from the soils through runoff and soil erosion; and
- improving overall soil physical, chemical and biological conditions through complex interactions of the above processes.

Trees also play a vital role in climatic moderation, at least at the microclimate scale. During the peak summer period, air temperature under the canopy to Acacia tortilis declined by up to 2□C. Similarly, it has been established that during the monsoon period, the soil temperature just beneath tree cover can be up to 16□C lower in the top soil zone, and up to 5□C at a depth of 30 cm when compared with open field conditions. This indicates a better soil thermal regime.

non adapted species, or the little attention given to biotic interference.

Success with integration

As part of its regular activities, the Central Arid Zone Research Institute (CAZRI) has been trying to find out a feasible approach for optimizing tree density in this region, and thus promoting sustainable agroforestry systems. CAZRI is part of the Indian Centre for Agricultural Research. For more than six years (since 1999), part of its work has been taking place in the villages of Dunda and Kawas, in Barmer district, Rajasthan. The whole district is highly drought-prone and soils are sandy.

Work started by looking at the traditional agroforestry systems and the programme has been implemented in steps. A survey was done. Results helped define traditional techniques which were to be promoted, such as (i) the use of pond silt for fertility improvement, (ii) the use of leaves of *Calotropis procera* for termite control, and (iii) the selection and growth of native tree species for the best use of prevalent social setup and edapho-climatic conditions.

Three native species well adapted to ecological and social conditions, were selected for planting. These were *P. cineraria*, *T. undulata* and *A. senegal*. A fourth species was chosen: *C. mopane*, an exotic fodder shrub which has been tested for four decades in arid conditions. Uses of these species are traditionally known. Leaves of *P. cineraria*, for example, are used as fodder, and its pods as vegetables. *T. undulata* is used for timber wood, *Acacia senegal* for gum, fodder and fuelwood. As some of these species start economic production from the second year, farmers do not need to wait for a long time before seeing clearly the benefits of their efforts (even if a minimum of 10 to 15 years are required for soil and micro-climatic improvement).

Establishment of a farmer's nursery: All the seedlings required for the programme were grown at a local nursery, managed by one farmer. As expected, this arrangement showed many advantages over the common practice of transporting seedlings from other regions. Farmers of the area were given the choice to select the species they preferred, having an emotional attachment to each from the time the seed germinated. This helped a lot and acted as social fencing in nursery and after transplanting. More importantly, seedlings were grown in exactly the same conditions (soil, water, climate), and no transplanting injury occurred. And, farmers transplanted seedlings as rains occurred - considering the highly unexpected rainfall patterns, this helped a lot in tree establishment.

Profile modification: Soils in these districts are known to have very poor water holding capacities, as well as poor nutrient supply. Various combinations of locally available materials were tested in CAZRI's laboratories for enhancing soil properties. Of all, the one consisting of natural soil, pond silt (Nadi), Farm Yard Manure and sand was preferred and used, basically due to its cost effectiveness and to its inclusion of native biological flora. In fact, the relief work of the government during March-June, which included, desilting of ponds came in handy to this programme. The silt removed from these ponds were used for improving the soil profile. Thus, a well-synchronized activity which on one side increased water storage capacity of the ponds and on the other side improved the water-holding capacity of the plantation pits, was taken up. The improved water holding capacity and better nutrient supply due to profile modifications contributed for enhancing survival and growth of plants.

Rainwater harvesting: Water scarcity in the region necessitates rainwater harvesting for the survival and growth of plants. Five farmers' fields in each village were selected. Two water harvesting techniques i.e. microcatchment and ridge & furrow methods were tried out after necessary land shaping.

Plantation in rows: As mentioned, naturally regenerated trees grow haphazardly in the field and obstruct use of tractors. Since it is very difficult to convince farmers of not using tractors, farmers agreed to plant the seedlings at an optimum distance (20 x 10 m), in a way in which crop cultivation and mechanized field operations were not obstructed. Transplanting was done just after one good rain (saturated soil) preferably in drizzling condition to get maximum benefit of rainwater and minimize transplanting shock. Planting was done with about 50 trees per hectare, having approximately 10 plants of *P. cineraria*, 10 of *A. senegal*, 10 of *T. undulata* and 20 of *C.mopane*, and thus balancing the various benefits of each species. To protect these trees from stray cattle, each newly planted sapling was fenced with locally available thorny wood of *P. juliflora* plant.

Results

CAZRI's experience illustrates that successful tree establishment depends on integrated approach and timeliness of operations e.g. transplanting, protection etc. Results showed that moisture retention due to microcatchment was double as compared to without catchment. This contributed to better survival. Survival was even better in control conditions (52-66%) as compared to other plantation program (10-15%) mainly due to protection. Mean height was also almost double in the treatment of catchment as compared to control. Thus, overall high survival and growth shows the success of this integrated efforts and farmers participation in terms of regular maintenance and protection of plantation. It was also observed that at least 3-4 year care and protection is required for successful establishment of trees. The yield of various produce from these tree species and monetary returns had already been calculated in previous studies. Also, the environmental improvement with trees was studied. Therefore, it can be estimated that the proposed system will increase income from one hectare by Rs.10,000-12,000 with increase in system resilience to drought, the prime requirement for sustainable system in this region.

Farmers of the nearby areas have started making nursery and earning income by selling plants in the village. However, it is difficult to convince the forest department about this highly decentralized and effective way of tree establishment. May be, in due course of time, some policy measures may improve this condition.

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Sharing knowledge on agrodiversity for conservation and livelihood improvement

Supporters of small-scale farming claim that it provides livelihoods, and it can also conserve agrodiversity. In an attempt to show this, an international network of scientists joined hands with farmer communities to document agrodiversity. By sharing this knowledge with other farming communities, they showed how it is possible to achieve the twin goals of biodiversity conservation and improving local livelihoods.

Luohui Liang and **Harold Brookfield**

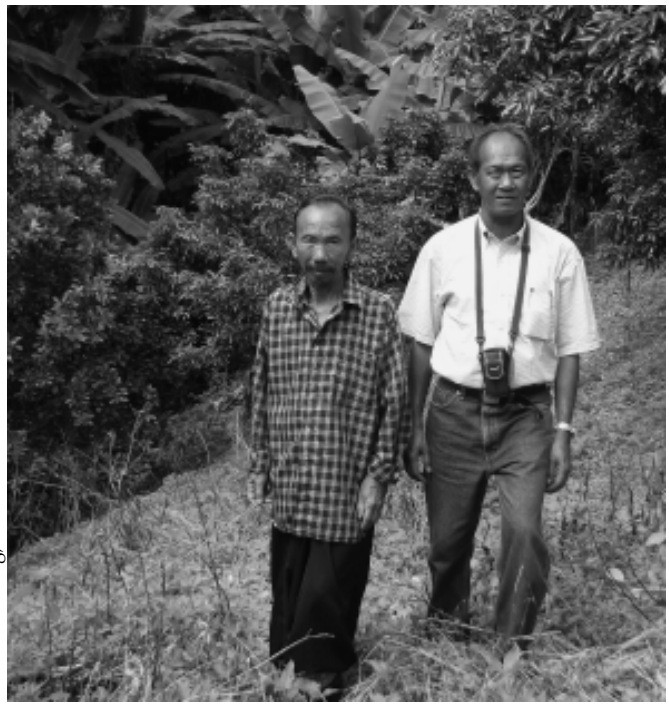

Photo: L. Liang, PLEC

Farmer meets scientist. People from different walks of life got to know each other while studying specialised local knowledge and crops.

Agricultural systems are a dynamic patchwork of different land uses such as annual cropping, orchards, agroforests, fallows, or home gardens. They are home to a great diversity of plant species and genetic varieties. Such systems are threatened by widely promoted monocultural practices of "conventional agriculture". Many organisations have been defending agrodiversity for decades now, supporting the 1.6 billion or so small farmers who experiment with their old practices to keep them alive. You cannot conserve agrodiversity by throwing up a fence around an area to keep "modern" ways out. You have to encourage farmers to keep practising and developing farming.

The "new ecology" in the 1980s held the view that biodiversity can be sustained in agricultural landscapes. Few ecosystems are in balance, and some disturbance to these systems may best promote biodiversity. Farmers' management may be just such a positive disturbance that can sustain biodiversity. This article explains how a global network of researchers showed that small-scale agriculture, besides providing livelihood to farmers, indeed "produces" biodiversity as well. The project tried to figure out how farmers could be supported to sustain such diversity well into the 21st century.

Farmers and scientists work together

Since the early 1990s, the United Nations University (UNU) project on People, Land Management and Environmental Change

Examples of how farmers all over the world maintain diversity

In **Tanzania**, an expert farmer conserved a woodlot with the greatest diversity of trees, shrubs and grasses in the whole community. Most of the trees are natural but some were collected from other places to enrich the economic and social values of the woodlot. Some of the added tree species were among those considered by the farmer to be endangered due to excessive use. Through farmer field days and meetings, he was able to convince some of his neighbours (including those who had been stealing from his woodlot) to plant and conserve their own woodlots. The woodlot also serves as an example for the community to prepare and plant tree seedlings on degraded land.

The team in **Brazil** encouraged community actions for establishing lake and forest reserves with over-exploited or rare wildlife, birds and plant species. Expert farmers there taught others about enriching fallow stages. For example, farmers made small openings in their fallows for planting semi-perennial species such as bananas, and for transplanting seedlings of desirable species.

In a site with yam, the cluster in **Papua New Guinea** organised a field day to show farmers the richness of yam diversity in their possession. More than 30 cultivars of *Dioscorea esculenta* and 20 cultivars of *Dioscorea alata* were displayed. A number of very large *D. esculenta* tubers were arranged in a container like in customary exchanges.

Photo: L. Liang, PLEC

Edge management received particular attention. One expert farmer in **Thailand** made more money through different crops cultivated in field edges, than from monoculture of cabbage or lychee. He also maintained medicinal herbs, wild vegetables and fruits on the edge of the agroforest. In the Fouta Djallon of Guinea, dead wood fences consume scarce wood and require much labour to repair. Using local examples, PLEC-Guinea demonstrated techniques for using live fences as an agroforest edge. In addition to saving wood and labour, live fences provide firewood, construction wood, fruit, medicines, mulch, or fodder. They also have ecological uses such as wind-breaks, soil fertility improvement, shelter for small wildlife; all with conservation value.

On the integration of plants and animals in a seasonally flooded habitat, PLEC-**Peru** identified tree species that produce fruits, which several fish species feed on and disperse, helping to restore part of the tree cover. These efforts demonstrated a way to achieve complementary integration of plants and animals in an agricultural system.

(PLEC), has been developing models of biodiversity conservation in agricultural systems in developing countries. PLEC operated through a global network of groups in Africa (Ghana, Guinea, Kenya, Tanzania, Uganda), Asia-Pacific (China, Thailand, Papua New Guinea), and Latin America (Brazil, Jamaica, Peru, Mexico). Scientists from Australia, United States, Britain, and Japan also participated. Each cluster was multidisciplinary, involving different institutions. UNU and the United Nations Environment Programme (UNEP) jointly implemented the programme.

Although farmers' practices may be broadly similar over quite wide areas, there are always differences in detail. These can include differences between the practices of richer and poorer households, households of different ages and gender composition, and sometimes between whole communities or sub-communities. Other differences arise between the better skilled and the run-of-the-mill farmers. Agrodiversity can therefore never be understood except at a local level, through long-term observation and familiarity with the farming people. To research such diversity, PLEC created groups ("clusters") of scientists working in close contact with the farmers of quite small areas, usually one or two villages. The scientists had to become familiar with the farming systems, and the variation within them. They identified "expert farmers", those who farmed better, conserved better, and often made more profit than their neighbours. Site selection was based on regional biodiversity importance, threats to biodiversity and ecosystems, known examples of agrodiversity, existing partnerships with communities, and availability of historical information. Some sites chosen were those where project members had worked before. They developed into demonstration sites where farmers could show their skilled management.

Identifying agrodiversity research sites

It took quite a while to understand how demonstration sites should be set up. Before early 1999 some clusters carried out reconnaissance work along large transects, extending over many kilometres and several agro-ecological zones. This made it difficult for scientists to develop genuine coalitions with farmers, and other local stakeholders on the ground. In some sites, scientists developed closer links to farmers, and such sites became gradually hotspots of exchanges between scientists, farmers, local communities and other interested people. Basic guidelines for data collection were developed in 1998.

All sites chosen were in agricultural areas with significant biodiversity, often close to parks or reserves. Two of the three sites in China were next to state natural reserves. Several others were close to natural areas reserved by custom rather than law. The first site developed in Ghana was set up at the invitation of a chief who sought help in protecting a sacred grove. Twenty-seven demonstration sites eventually became operational in areas of international biodiversity importance or near "biodiversity hotspots". As demonstration sites, people from much wider areas could see them. The more energetic research groups organised publicity for the sites and their work.

Generally, surveys were made at each site to identify the different land use stages, and within them, field and fallow types. Scientists then sampled households and plots. Farmers showed plant species and management practices on the sampled plots and household economy, which scientists recorded for analysis. With this information, PLEC clusters could compare between land use stages and among households and communities, to discover expert farmers and understand their expertise. Biodiversity was also assessed at this stage. Thus, the project could show that farmers are not destroyers of biodiversity but rather conservers. For example, in Mazagão, Brazil, farmer-managed fallows were more diverse than abandoned fallows. The PLEC teams then figured out what practices and incentives led to this increase of diversity in the farmer's fallow, and whether this enrichment would also lead to an increase in biodiversity at a landscape and regional level.

Sharing farmers knowledge

The next step was to promote expert farmers' technologies and knowledge. Farmers often obtain new ideas and technologies through exchanges with other farmers, and observation. They prefer to see concrete results. Therefore, the expert farmers demonstrated

In **China**, an expert farmer experimented with domesticating a rare and locally preferred timber species found in the forest, *Phoebe puwenensis*. Within two years he had succeeded in growing viable seedlings (not known to plant breeders). He then converted 0.13 ha of sloping land into a tree plantation, which generates income and conserves soil. Through PLEC-China he helped another 95 farmers in his village to adopt the same technology. This activity helped to enrich the monoculture plantation of *Cunninghamia lanceolata* which had been promoted by the government extension system. It also reduced the potential threat of illegal logging of *Phoebe puwenensis* in the natural reserve near the village.

One group of women farmers in **Ghana** compared the characteristics of 12 indigenous varieties of African rice, *Oryza glaberrima*. In contrast, male farmers had switched to "improved" rice and had largely forgotten even the names of indigenous varieties. On-farm trials showed that two of the indigenous varieties had high yield potential and compared well with the introduced varieties. Some indigenous varieties had properties that women prefer, such as being a good baby food, cooking easily, and keeping well overnight. As the normal seed exchange system does not provide enough of the indigenous varieties, the womens' group was encouraged to set up a community seed plot. In this way they could multiply seed of the indigenous varieties they prefer. They also worked to improve storage facilities.

Photo: L. Liang, PLEC

Moko disease has largely destroyed the banana monoculture of Amapá, **Brazil**. Local expert farmers experimented and learned that leaving some *Heliconia* spp. (and other understory species) scattered among bananas trees, could mitigate the Moko disease. This is called the banana *emcapoeirada* agroforest system, which they taught to others. This system is helping farmers regain profitable banana production by managing the Moko disease, increasing biodiversity and also adding a number of products from plant species other than banana.

On inter-species diversity, the team in **Guinea** worked with village women on the revival of an ancient trade of dyeing cotton cloth with local plants of the *Fabaceae* family. For the women, this became an activity with a significant income. Because of increased pressure on the trees, assistance in planting the principal species used in dyeing became a part of PLEC demonstration activity, and the women started growing cotton.

their practices to fellow farmers and extension staff. The elements of diversity management were broad. Farmers explained about diversity within species, between species, at landscape levels, about the associated diversity for soil fertility, pollination and pest regulation, and the integration of plants and animals.

Contrary to a commonly held view that agriculture is a threat to biological diversity, PLEC has demonstrated globally how farmers in fact enhance the conservation of local biodiversity. They achieve this while attempting to make a living, and improving their own livelihoods. The concepts, methodology and examples developed during the PLEC project contribute to the global efforts to achieve the twin goals of biodiversity conservation and improving local livelihoods.

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Photo: L. Liang, PLEC

Many clusters knew about biodiversity for soil conservation, pollination and pest regulation. PLEC-**Ghana** facilitated some revival of *oprowka*, a traditional no-burn farming practice that involves mulching by leaving slashed vegetation to decompose *in situ*. The practice maintains soil fertility by conserving soil microbes and by humus addition through the decomposing vegetation, and conserves plant propagules, including those in the soil, by the avoidance of fire. In Uganda an expert farmer taught others how to enrich banana gardens with other plant species for apiculture.

LEISA's Farm:

A blog about sustainable family farming

Our new blog (short for weblog) has been running for a few months now, and we would like to invite you to join us!

A blog is another way of linking up with each other. Blogs can follow, comment on and discuss news and current issues immediately. Blogs deliver fresh content in a fast way. They are also a place where new ideas can be presented, and experiences shared in an interactive way.

As you can imagine, the entries on our blog cover many topics, but they are all related to sustainable family farming. Our blog is an accessible way of exchanging information that we think readers would find useful or interesting. There is a new entry every few days, meaning we can cover more news items, events and hot topics than possible in a quarterly magazine. For example, there was a recent entry about a new project which has started putting audiofiles (or podcasts) with agricultural information on the internet, for local radio stations to download and broadcast to farmers in remote areas in northern Peru. There have been updates from international conferences, as well as practical suggestions, like how to purify water using transparent plastic bottles and the energy of the sun. Most posts have links to further information and websites. You can also add your own comments, suggestions or experiences. We hope this serves as another way of inspiring you in your work and daily life, and gives you another opportunity to exchange your ideas with others.

To keep in touch more easily, you can sign up to receive an e-mail each time we add a new post, or you can use RSS. To access both, you need to visit the site. If you have any questions, or have something you would like us to share with the world, send an email to: leisasfarm@gmail.com and we will add some of your ideas to the blog too.

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Visit LEISA's farm at www.familyfarming.typepad.com

Traditional wisdom of Apatanis – a way to sustainable wet rice cultivation

The art of rice cultivation has descended from one generation to another in Apatani tribes. The practice based on traditional wisdom which has sustained over generations, has made rice production economically viable, ecologically safe and often energy efficient.

Manish Kanwat, P. Suresh Kumar, M. Singh and **R. Bhagawati**

Rice is one of the most important crops of the North Eastern Hill states. It occupies a distinct position and has well defined role in the food and nutritional security of tribal, backward and hilly areas. In North Eastern Region, the agricultural practices are diverse, ranging from shifting agricultural system, fallow system and secondary system such as wet rice cultivation. These traditional technologies developed over many generations are often energy efficient, providing high economic returns to the farmers.

Highly evolved agro-ecosystem in Apatani plateau

The Apatanis, are mainly concentrated on upper subansiri district of Arunachal Pradesh. They are one of the relatively advanced tribal societies in North Eastern Region of India. They have a highly developed valley cultivation of rice perfected over centuries. Apatani rice ecosystem is highly productive (40-45 q/ha), around 3-4 times the average yield of rice in the state. Use of low external inputs makes it not only economically viable but also sustainable.

Land preparation starts in the month of April and all the operations are done manually by indigenous wooden tools like *hilta* and *hitta*. The terraces in the main valley are quite broad, perfectly leveled and provided with strong bunds. These bunds are made up of soil and supported by bamboo at base, to prevent soil erosion due to runoff. Slope of land in the main valley ranges from 1-8%. Perfect leveling of plots and well managed irrigation cum drainage channels reduce the soil erosion considerably.

Farmers prefer local varieties viz., *Emo*, *Pyaping*, *Pyat*, *Mipya*, etc. having long duration i.e. 190 - 278 days. *Emo* variety covers 68%, *Pyaping* covers 15% and *Pyat* covers 10% of the total rice area. In Apatani village, people make effective use of their irrigated land by planting early and late varieties of rice. Closer to the village where conditions are more favorable, late variety is preferred. Early variety is sown farther away from the village where disturbances by animals and poorer irrigation facilities could be major constraints. Thus, the rice plots closer to the village are nutritionally richer than those farther away. Fish culture done here synchronizes well with late ripening rice variety. Further, rice is supplemented with finger millets cultivated on elevated partition bunds between the rice plots.

The Apatanis do not use draught animal power for the cultivation of rice as well as other crops. There are many traditional practices used for minimizing the insect pests and diseases of crops. For example, *Gundhi* bug is managed by fixing several short wooden/ bamboo stick randomly at certain intervals in the rice field. Dead frog/crabs or dry salted fish are placed on the top of each stick to attract the adult *Gundhi* bugs.

Productivity of rice varieties is high in *Emo* variety with 52 q/ha followed by *Pyaping* (40 q/ha) and *Pyat* (32 q/ha). Around 40 % of the rice produced is sold to the economically weaker neighbouring tribes such as Nishis and the hill Miris.

The Apatani village ecosystem is a good example of economic self sufficiency of a traditional agricultural society that produces ecologically sound sedentary agriculture in the North Eastern Hill Region of India. However, the agro-ecosystem of Apatanis could be improved through appropriate crop rotation and product utilization of the land during the winter season.

Though not scientifically validated, these traditional practices which have descended from one generation to another have been sustained through experience. There is a need to learn about additional indigenous practices so that these could be improved.

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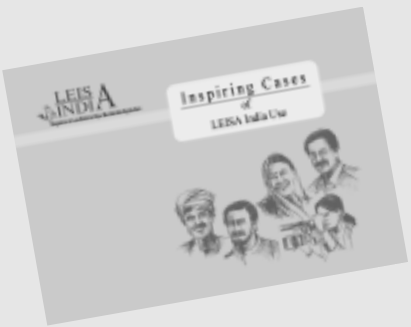


LEISA India readers are not just readers – many of them are promoters and practitioners of LEISA. While practitioners seldom share, our reader practitioners have been patient as well as enthusiastic in sharing how they have used the content of the magazine.

Inspiring cases is a collection of cases indicating the diversity of influence of LEISA India magazine on the minds of readers. We have included the narration of experiences by the readers themselves as well as three interviews. We earnestly believe that they in turn would inspire many more to promote and practice LEISA.

To view the cases please visit: http://india.leisa.info

Indigenous farming system of Adi tribes: Source of food, nutrition and medicine

Hill farming system involves diverse crops and their varieties, medicinal plants, forest species, practiced by the Adi tribes of Arunachal Pradesh. These tribal farmers are conserving biodiversity and meeting the food, balanced nutrition and health benefits from this farming system. Recognizing and rewarding the custodians of biodiversity and conserving the plant species in different ecologies is essential for the utilization of the potential of these species in the future.

S. K. Sarangi

The Adi tribes are the largest tribe of Arunachal Pradesh (9% of total population of the state) inhabiting in the districts of West Siang, East Siang, Upper Siang, Upper Subansiri and Dibang Valley. However, the majority of this tribe is concentrated in three districts viz. West Siang, East Siang and Upper Siang. The climate of the region is temperate to humid sub-tropical with abundant rainfall of more than 2000 mm per annum spreading over eight months in a year (March to October). The tribe consists of number of sub tribes. They are believed to be the descendants of the Abo-Tani (Abo- Father; Tani- Man). They live in over 50 hill villages, under a selected village chief called Gaon Burrah who moderates the village council (Kebang), which acts as traditional court.

Adi tribes largely depend on shifting cultivation, popularly called *jhumming* (the land in which this is practiced is called jhum land), settled agriculture (kitchen garden and valleys) and adjacent forest for livelihood. The land ownership is of two types: community and individual family. Each village has a certain portion of land for community use and other land is owned by individual family (Table 1).

Almost every household owns a piece of land. However, farmers with marginal and small holding compensate their subsistent needs from animals, forest, fishing etc. The jhum land is utilized after cutting and burning the vegetation generally for the first two years and kept fallow for regeneration of fertility for subsequent 3 -10 years.

Adi farmers are very conservative in maintaining the soil fertility and have strong belief that application of chemical fertilizers will make the soil hard and unsuitable for crop growth. The fertility of jhum land is maintained through in-situ incorporation of burnt vegetation and in kitchen garden and orchard by applying manure of domestic animal. Soil erosion in the sloppy jhum land is controlled by keeping half burnt long wooden logs across the slope of the land, which after the cultivation period decompose and add nutrients to soil. The input for all forms of agriculture is from the system itself. However, there is exchange of seed and planting material within the community.

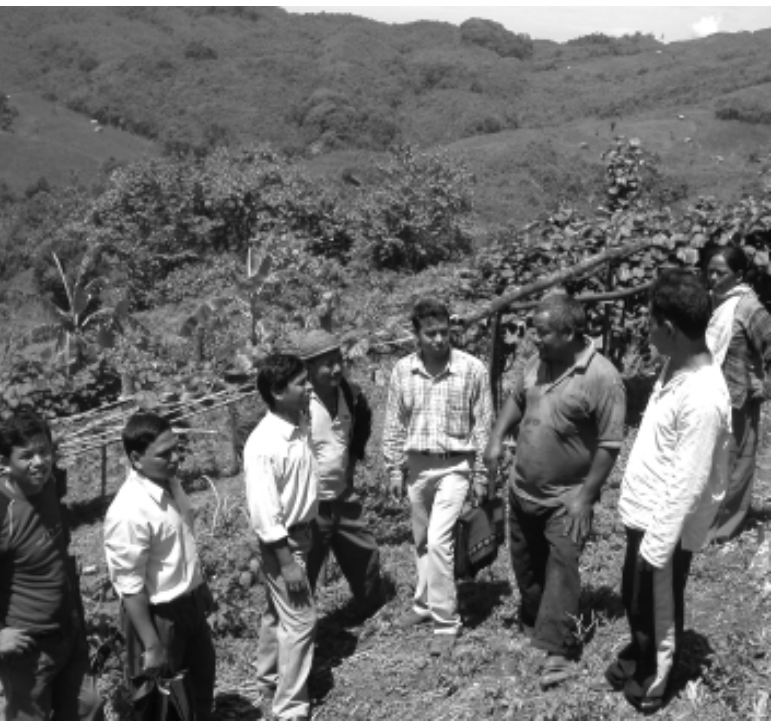
Maintaining diversity

Women play a vital role in seed preservation and maintenance of genetic diversity. The *jhum* system maintains a high crop diversity comprising of cereals (rice, maize and millets), pulses like rice bean (Vigna umbellata), oilseed (sesame) and vegetables (brinjal, cucumber, bhindi etc) with rice as the major crop. Maize crop is sown sparsely in the entire area with rice. Millets and other crops are grown in the boundary of the jhum land. Root crops like local yam and colocassia are sown after harvest of rice and maize. The yield from jhum land in the first year is generally higher than the second year. However, the yield from wetland rice cultivation (WRC) in the valleys is always higher than jhum cultivation. The comparative output: input ratio is 1.25, 1.50 and 1.75 for second year *jhumming*, first year *jhumming* and WRC, respectively.

Farmers with their age old experience in farming developed a comprehensive knowledge on the nutrient content and medicinal properties of various plants. Pseudocereals, small millets, indigenous pulses, oilseeds and many more forest plants form important component of food source for these tribal people of Northeast India. The adjacent forest products are still utilized on day to day basis as dietary supplements and some are also often sold in local markets. These species have been used as life-sustaining food as well as medicines, from time immemorial. Apart from providing diversification of the food base, different indigenous fruit species produced at different times of the year, ensure year round supply of nutrition.

Table 1: Land types and source of livelihood in Adi tribes

Land Type	Ownership	Source of livelihood	Avg. % of holding size
Permanent forest	Community	Timber, fire wood, cane, bamboo, palm leaves, bamboo shoot, medicinal plants, wild edible fruits, vegetables, flowers & mushroom, habitat for semi domestic animal Mithun	-
Jhum forest	Individual family	Rice, maize, millets, rice bean, traditional vegetables during jhum period and act as permanent forest during fallow period	45.0
Orchard	Individual family	Orange, lemon and pineapple	24.0
Kitchen garden	Individual family	Local green vegetables, medicinal herbs etc.	10.0
Valleys (low land)	Individual family	Rice and fish	21.0



The farm is the biodiversity factory fulfilling basic needs

Due to the consumption of a variety of vegetables, fruits, and chemical free food stuffs, the resistance to diseases is very high and deficiency of vitamins is very less. A large number of wild plants or their parts still supply food to large section of human being in this hilly state. Perhaps, this is the only way of having a healthy and balanced diet by consuming as many different foods as possible which are grown in their own farm adjoining the habitation. A large number of indigenous plants are used as medicine for curing the ailments like skin diseases, gastro intestinal disorders, blood pressure, bleeding due to accident etc. Therefore, these people rely very less on the modern system of treatment for their common health problems.

As many as 48 species of grains, vegetables and medicinal plants, 25 species of fruits and 13 species of forest plants are grown in different combinations in their traditional agro-ecosystem. Some of these plants are identified and conserved in the research farm of ICAR Research Complex for NEH Region, Arunachal Pradesh centre, Basar. Besides ecological and economic benefits, risk of crop failure is minimised due to cultivation of a variety of crops in the same piece of land. The traditional farming system of Adi tribes is also organic in nature, ultimately benefitting the health of the community.

Crop diversification minimises risk and provides balanced nutrition

Integrating knowledge sources

The community has strong faith in their traditional agricultural practices. They never replace them with modern practices unless thoroughly convinced of its ecological implications. There have been formal extension agencies like state agriculture and horticulture departments, multiple cropping project (MCP) and irrigation and flood control department (IFCD), but they have been limited to supplying some inputs (seeds/fertilizer) which farmers have seldom used. Until now, the practices followed in the *jhumming* are purely traditional, gained from years of experience and ancestors. However, in the settled agriculture like orchard and WRC, they sometimes add knowledge from extension agencies, for example new knowledge on maintenance and rejuvenation of old declining orchards and use of improved seed/planting material.

Conclusion

The Adi tribes of West Siang district of Arunachal Pradesh practice their own way of traditional farming system with wide variety of crops, which provide food, fodder, fuel, fibre, nutrition and medicine to the community. In days of famine and other natural calamities, these under exploited crops and vegetables have an important place as a staple food for human beings. Most of these vegetables and land races, which have specific nutritive values are facing the danger of extinction today. Therefore, cultivation of these endangered and under exploited plants in different ecological situations is essential to conserve biodiversity and utilize their potential for upliftment of economically poor population. Further, the approach to agricultural development should be built on locally available asset base, rather than modifying it.

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Sustainable farming system for balanced ecosystems

The small farmers of Central Himalayan region are achieving high level of diversification through rotation of pure crops in space and time, and through mixed cropping systems. The system with a potential to feed the hill population and conserve natural resources, requires serious attention from the policy makers, to survive.

Vikram S. Negi, and R. K. Maikhuri

The Central Himalayan mountain region (Uttarakhand State) is well known for its rich and diverse natural resources. Large sections of the Himalayan population largely depend upon agriculture based activities for their livelihoods. Traditional agro ecosystems in the Himalayas constitute interlinked production systems like crop husbandry, animal husbandry and forests. Inaccessibility, environmental heterogeneity and ecological fragility favoured the evolution of subsistence production systems, sustained with organic matter and nutrients, derived from forests. The traditional settled agriculture of this region exhibits a great deal of diversity in crop composition and crop rotations. Even though holdings are small, the number of crops cultivated by a household may vary from 17-30. A high level of diversification is achieved through rotation of pure crops in space and time, and through mixed cropping systems.

Hill farmers of Uttarakhand evolved, through centuries of informal experimentation, a system of agricultural production that is most suitable for the prevailing undulating, sloppy lands with poor soil depth and fragile ecosystem. Its chief feature is conserving soil, its surface and subsoil fertility through application of organic manure and plant biomass. Both rainfed and irrigated agriculture are important agricultural land-use systems in the region.

Crop rotations for maintaining soil fertility

In most of the cases, the land of the villages in mountain region is divided into two parts (sars). Rice is grown in one part and mixed cropping is done in another. In a typical two-year crop rotation cycle, in the month of April of year one, wheat is sown (in the land which was lying fallow after the mixed cropping was over in the month of October), which is harvested in the month of October. After harvesting the wheat crop, paddy is sown in the same land which is harvested in April. During the second year, mixed crops of millet, pseudomillet and grain legumes are grown on the same piece of land. After harvesting these crops in October, the land is left fallow for six months, till March. In this process, farmers raise three crops in two years. In this way, the same crop is repeated after one and half year, on a particular piece of land. This crop rotation is an important feature of the system and helps to maintain the diversity of species grown, and in management of soil fertility. Importance of pulses (legumes) as a "Soil Fertility Maintainer" cannot be ignored which is an important part of crop rotation.

Mixed cropping for diversity and food security

Mixed cropping of millet and pseudomillet with grain legumes is a common and very important practice in traditional Himalayan cropping systems. The traditional intercropping practiced here is a heterogeneous mixture of various local legume and non-legume crops and is locally termed as "*Barahnaj*". It means traditionally more than twelve grains and pulses are harvested in the monsoon season from same field which is an effective mechanism to avert total crop failure to ensure food security. *Elusine coracana*, *Amaranthus spp*, *Chenopodium album*, *Hordeum vulgare*, *Pisum arvense*, *Vigna mungo*, *Macrotyloma uniflorum*, *Phaeolus vulgaries*, *Glycine max*, *Perilla frutescens*, *Sesmum indicum*, *Cajanus cajan*, *Vigna angularis*, *Vigna unguiculata* etc., constitute the principal crops of *Barahnaj* system of the central Himalaya in Uttarakhand. Mixed cropping in addition to enhancing biological yields, also improves food security.

Building soil fertility

Several forms of organic farming are being successfully practiced in diverse climatic conditions, particularly in rainfed, tribal, mountainous and hilly areas of the state. Among all farming systems, organic farming is gaining popularity among farmers. It is managed through use of farm yard manure, which is one of the most useful and significant indigenous methods practiced almost in all the villages of the region, This system is further supported through mixed cropping systems and crop rotations to maintain the soil fertility and agrobiodiversity.

The organic products are gaining worldwide popularity due to high nutritional value and having no harmful effect on human beings. Proper processing and selling through organized channels could enhance market value of their products. Farmers have created marketing network through various NGOs - 'Uttarakhand Mahotsav' in Dehradun, 'Gaucher mela' in Garhwal region and 'Pithoragarh mela' in Kumaon region of Uttarakhand. Even the International Trade Fair in Delhi creates some space for such products. These platforms are enabling farmers to access quicker benefits.

The need for recognition

The importance of mountains for human subsistence cannot be overlooked. Mountains are the direct life-support base for people living in the region and also provide goods and services to majority of the population. The hill agroecosystems with traditional crops are ecologically and economically viable and have the potential to support the food requirement in the Himalayan region. So, the sustainability of agriculture is directly linked to the surrounding ecosystems and sustainable livelihood of the region.

However, in the recent past, agriculture has been ignored by almost all the governments, both at the state as well as the national levels. Despite the fact that Uttarakhand is a predominantly mountainous state, it has no mountain agriculture specific development policies. There are many studies that tell us that the future is bright, but there is a need to follow the right policies, implement strong institutional initiatives, research and to incorporate some positive options.

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Underutilised trees offer hope for tribal communities

Tribal farmers in India are being encouraged to plant underutilised indigenous wild trees on their land. This is in response to the fact that, in recent times, farming systems in central India have become less diversified and natural resources are becoming scarcer. Tribal communities living in remote areas are specially affected. While forest products were previously a major source of income, they are now being overexploited. Promotion of underutilised species can diversify farms, preserve forests and provide opportunities for income.

Abhay Gandhe and Arun Dolke

Photo: Abhay Gandhe

Learning to cultivate and harvest lac has offered a new income opportunity and a more diverse farming system for this tribal farmer.

The two main crops grown in central India are rice and cotton. While other minor millets, pulses and oilseeds are also grown, many farms have evolved to now operate as monocultures. Farming systems have become less diversified, soil and water resources have become poorer, and growing populations are putting more pressure on limited land resources. If a main crop fails, farmers suffer as they have few options to fall back on. With systems becoming more unsustainable, communities are increasingly using natural resources from surrounding forests. This can result in overexploitation and the loss of biodiversity. Farmers need additional opportunities within their existing farming systems. This is especially true for tribal farmers who inhabit more remote and marginal areas.

BAIF Development Research Foundation, in Pune, India, has established a Resource Centre for Tribal Development (RCTD) to identify and develop potential new interventions for tribal communities. Tribal farmers are indigenous communities generally living in forest fringed remote areas and practising subsistence farming on small land holdings. Collection and sale of a variety of non-timber forest products (NTFP) constitutes a major source of livelihood for tribal farmers. However, widespread poverty, degrading agriculture and the vague tenure status of wild NTFP trees is leading to their overexploitation. Crop diversification has been identified as a key measure for countering the threats of degrading farming systems. However, BAIF and RCTD realise that there are limitations to developing the existing agricultural situation in marginal locations in tribal areas. Therefore, an alternative strategy has been proposed: domesticating non-timber forest products as a major effort towards diversifying farming systems. The innovativeness in this approach is to focus on underutilised indigenous wild trees which have economic potential.

Promising but underutilised trees

Wild underutilised NTFP trees are domesticated by integrating them into existing farming systems. All NTFP trees are highly stress tolerant. They are hardy and establish well, with minimum care, on the neglected areas of farms. With technical advisory support and a strong sense of ownership for the trees planted on the farm, the farmers are expected to harvest the trees sustainably, thus, ensuring long-term additional livelihood support. In the long run, there should be a gradual shift towards harvesting of NTFP from privately owned trees, resulting in reduced harvesting pressure on forests.

The BAIF field teams and the participating farmers together identify promising trees for domestication. The following attributes are given special attention:

- high tolerance to drought and high summer temperatures;
- ability to survive on marginal soils;
- suitability for direct seed sowing or simple nursery techniques;
- resistance to browsing by stray cattle and goats;
- highly threatened status in natural forests due to overexploitation;
- the local population is familiar with the trees and their use, so that adoption is easy.

Three of the trees selected as priorities for domestication are described here:

The gum karaya tree, *Sterculia urens*

The karaya is found in tropical dry deciduous forests in India. It prefers unusual and stress prone habitats, occupying hilltops, rocky crevices, or eroded slopes. It needs very little water, and will grow on the poorest of stony soils. The karaya tree yields a valuable gum. Tapping these trees was a major livelihood activity for tribal communities in central India. At present, it is one of the most threatened NTFP trees in India due to overexploitation. It is nearly extinct in many areas where it was abundant in the past. Recently, several Indian states have banned trading this gum, in an attempt to halt the rapidly declining number of natural stands. However, in the process they are depriving traditional gum collectors of a source of livelihood.

The strong resilience capacity of this tree can be used to the farmer's advantage. A well developed tree can generate about 500 rupees (around US$ 10) annually from gum harvesting from the tenth year onwards. With about 25 mature karaya trees per hectare on his farm, a farmer has access to an additional income of about 12500 rupees (around US$ 255) which is hardly influenced by an

adverse climate. BAIF started propagating the tree through stem cuttings, but there are few large trees surviving locally. So we shifted to seed propagation. The fresh seed, harvested in April, germinates well and is fit for direct sowing. The radicle of the emerging seed quickly swells into a tuber and gives the fresh seedling strong drought tolerance. In the July 2008 season, about 75000 karaya seedlings were established on the farm bunds of tribal farmers. This number will increase in 2009. After about 10 years, the privately owned trees will be harvested by non-destructive methods of harvesting to ensure sustainability of production.

The flame of the forest tree, *Butea monosperma*

This is another exceptionally hardy tree which grows naturally in secondary forests and on neglected areas. It is extremely drought tolerant and resistant to grazing by all animals. Its compact size and tolerance to frequent heavy pruning makes it an ideal tree for agroforestry. The tree is best propagated through direct seed sowing of single seeded pods which are available in abundance in April. If planted in a single dense line along farm bunds, it is effective as a host tree for cultivation of the Indian lac insect, *Laccifer lacca*. Lac is the resinous secretion of a tiny insect that grows on a variety of trees known as lac host plants. Harvesting of natural lac is a traditional livelihood activity of the tribal communities, but is now overexploited and threatened. Cultivating lac needs technical but simple skills. The RCTD is ensuring that new lac farmers have these skills, through on-farm trainings. Five to six years after planting, the tree is ready for inoculation by lac insects, and needs very little maintenance till the gestation period. A grown tree can yield lac worth 50 rupees (approximately one US dollar) in a year. BAIF suggests planting at a density of about 300 trees on the bunds of one hectare. Domesticating this wild tree has the potential to generate additional annual income of about 15000 rupees, or just over US$ 300.

This tree needs little labour and is a truly multipurpose tree yielding firewood, manure, commercial lac and gum. The *Butea* plantation programme started on a trial scale in July 2007. It was possible to quickly scale it up in July 2008 to ensure the planting of about 120000 seedlings across central India. Due to its easy establishment, the programme is expected to grow and spread quite fast in the near future.

The bauhinia tree, *Bauhinia purpuria*

This tree is occasionally found in the urban areas of South Asia as an ornamental tree. In the remote tribal areas, its leaves are a popular green vegetable. In the forests, it occurs as a scattered tree. However, compared to the demand for vegetables, the trees are few and overexploited. In April, the tree puts forth fresh leaves that are plucked as vegetables. Removing too many leaves weakens the tree. Every tribal family is being encouraged to plant two or three *Bauhinia* trees in their own backyard gardens. During July 2008, about 5000 seedlings were raised in nurseries and given to about 5000 families. This small initiative will be scaled up in 2009. It is expected that the newly planted family-owned trees will be ready for use as a vegetable after about five years. The trees have a special role in human nutrition as the green vegetable is available during the dry summer season when other cultivated vegetables are not available in rural markets.

In addition to generating livelihoods and building resilience back into degraded farming systems, this BAIF initiative will also encourage *ex-situ* conservation of many threatened Indian tree species.

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Themes for LEISA India

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Women and food sovereignty

Food sovereignty is about the right of producers to define their own food, agriculture, livestock and fisheries systems – as opposed to having them defined by international market forces. For small-scale farmers this means having the right to land and resources, and being able to participate in decision-making about resources in their countries – to ensure that their families and communities have enough food, before their produce enters long-distance trade. Food sovereignty is a relatively new concept, propagated by La Vía Campesina and several NGO led movements in India. It is a response to the dominant thinking in development that farmers need to be modernised, by stimulating them to enter into commercial globalised trade.

What does food sovereignty mean in the day-to-day lives of small-scale farm families? And more particularly, what does it mean for women – being the main providers of food? We are interested to learn about how they perceive the global changes in agriculture, and how they respond to them.

How do these changes affect their roles as food producers, as mothers and feeders of the family? Do they have the rights of access to land, water, and forest products essential for securing nutritious food? How do women and their families balance between production for the market and for home consumption, between the need for money and the need for food?

At a time when a global economic crisis is unfolding, what is the scope for food self-sufficiency – at household, local and national level? What innovative strategies have farmers and their organisations developed towards gaining food sovereignty? What initiatives are being undertaken to support women and men farmers in achieving this goal? Many farmers are still a long way from true food sovereignty – what are the bigger challenges yet to be addressed?

Dear readers, we look forward to your contributions to this extremely important theme!

Deadline for submission of articles - 15th October 2009.

Mr Bairwa's diverse farm

Though the green revolution enabled India to attain food security, the technologies, subsidies and public support systems failed to address the problems of small-scale dryland agriculture. Diversified farming, being more economically and ecologically resilient, can reduce risk. Integrating livestock, growing a variety of crops and recycling farm produce as Mr Bairwa does, reduce the risk in farming. It also makes him less susceptible to price fluctuations.

Veena Vidyadharan and **M.K. Tiwari**

Photo: CECOEDECON

Mr Bairwa believes that growing a variety of crops can reduce the risk of crop failure, and provide a rich and varied diet.

Mr Babulal Bairwa is a small-scale farmer who lives in Sajia Village, Gram Panchayat Chanani, Rajasthan (in northern India). He owns about 1.5 ha land where he and his family practise agriculture, horticulture, livestock and poultry raising and have a flour mill. In 1996, the land was almost barren with only a few *babool* trees (*Acacia nelotica*). He cleared and levelled the area and made it suitable for cultivation. He planted about 45 trees along the farm boundary for fodder, fuel, shade and as a wind break. For irrigation and drinking he dug a well. Every other year he adds fertile top soil to the land.

Mr Bairwa has attended various exchange visits to research institutions and farmer's fields. He has also obtained loans for purchasing accessories like hose-pipes, sieves, fencing and a vermicompost unit through CECOEDECON (Centre for Community Economics and Development Consultants Society), a local NGO. This NGO promotes sustainable agriculture practices and organic farming in rural areas of Rajasthan. They emphasise the farmer-led approach and organise exposure visits and trainings for farmers like Mr Bairwa.

Sustainable agricultural practices

As well as having a diverse farm, making the best use of all products within his farm is key to Mr Bairwa's success. During the rainy season, Mr Bairwa grows pearl millet, sorghum, corn, sesame and cowpea. In winter he grows wheat, barley, mustard, and chickpea. He has a small kitchen garden where he grows vegetables, and he has planted about 300 fruit plants of which 275 are well established. He practises intercropping and raises crops in between the fruit plants, but believes that mixed cropping makes harvesting difficult. He purchases seeds of improved varieties which can be used for up to three years. He practises mulching and crop rotation, noticing that crop rotation reduces the incidence of pests and weeds. He finds that mulching reduces soil temperature, increases infiltration and adds organic matter to the soil.

He irrigates the field crops and fruit crops. He can predict a frost and remembers the advantages of irrigation and smoking in reducing the effect of frost. The lower portion of the field is kept fallow during the rainy season. This impounds rain water which improves the soil moisture for growing winter crops, and recharges the ground water.

Mr Bairwa prepares a bio-pesticide by mixing cattle urine with neem, *Dhatura* and *Calotropis* leaves and allowing it to ferment for 15 days. It is later filtered, diluted 10 times and sprayed on plants. According to Mr Bairwa, this keeps down the pest population and enhances plant growth. If the infestation is severe he resorts to chemical pesticides.

Mr Bairwa owns two buffaloes and two calves. He bought the buffaloes under a government scheme in 2005, when he got a subsidy. He grows lucerne for fodder, and feeds the livestock on green fodder, wheat straw, and oil cakes. The dung is used for manuring trees and preparing vermicompost. He prepares vermicompost in a shed during summer when there are no farm activities. Besides cattle manure, he uses tree leaves, kitchen waste and crop waste to prepare compost. By the rainy season, the compost will be ready and it is applied to crops, after which he uses the same shed for poultry. His buffaloes and poultry are both local breeds.

Farm based enterprises

He gets 10 litres of milk per day from the buffaloes, of which three litres is used in the household. The rest is sold to the dairy co-operative society. He realises that the eggs and meat of local hens fetch higher prices in the market. He applies poultry manure to vegetables and observes that it performs even better than vermicompost. Mr Bairwa also owns a flour mill which is an additional source of income for his family. The waste from the mill is used as a feed for buffaloes. He obtains an average of 1.5 kg of waste per day while cleaning the mill. These are some of the ways he recycles farm produce within his farm. Since labour is not available in the locality his family members assist him in all the farm activities.

Secure livelihoods with diversified farming

Mr Bairwa shows how it is possible for a small farmer to efficiently use his limited resources through diversified farming and make a good profit. By combining livestock with crops, he recycles farm produce. Despite frequent droughts and crop failure in the dry lands of Rajasthan, farmers are able to earn a steady income through livestock. Feeding and marketing are flexible in animal production systems. This can cushion farmers against trade and price fluctuations and, in conjunction with cropping operations, make more efficient use of farm labour.

■

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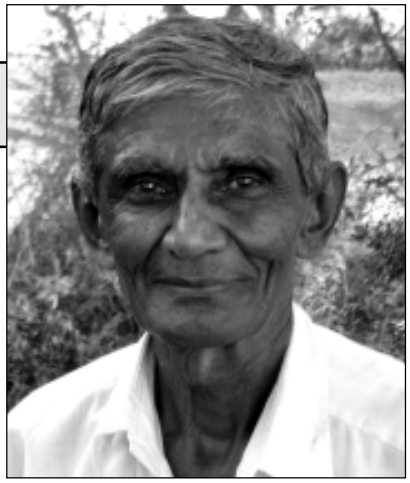
The Narayana Reddy Column



Diversified farming systems

Agriculture is most neglected by the union and state governments as the revenue it generates is meagre compared to other sectors like information technology, bio-technology etc. Surprisingly, it is being neglected even by farmers, as it is not a rewarding profession compared to others in terms of hard work, time and risk factors involved. But the main reason for this tragedy is that governments have not given enough importance to provide remunerative prices for agriculture produce on par with the cost of agriculture inputs. However, one thing is true – food is the most important commodity for any living being.

As a farmer, I have learnt during my 45 years experience that only crop production is not agriculture. This is particularly true in countries like India where 80% of the total farmers are small and marginal. At least for these farmers, agriculture shall be an integrated system of cropping and livestock. Tree cropping is for green manure, fodder, food, fiber, fuel and timber. Livestock should include a variety of animals like cow or buffaloes, sheep or goats, chicken or pigs which feed on farm wastes like grasses, hay and the like, pruned branches from trees and weeds, broken and immature grains, spoiled fruits etc and produce milk, eat, eggs, money etc and valuable manure.

Trees not only provide fodder, green manure etc., but also add enormous amount of biomass to soil, host beneficial predating insects and birds, conserve moisture from hot winds, conserve water from the soil, enrich the soil fertility by accommodating trillions of micro-organisms around their lengthy root systems and of course, income. Then the animals feeding on the farm waste, keep weeds under control with proper grazing and provide valuable manure on the farm. Their excreta shall be used as raw material for gobar gas plant producing cooking and lighting gas with value added manure for crops.

Coming to the choice of cropping systems, importance should be given to those needed for family consumption as well as local communities. But unfortunately, more importance is being given both by the government and by the farmers for commercial crops like cotton, tobacco, sugarcane, chillies, eucalyptus which are grown for export. These crops neither provide food, fodder nor fuel to the farmer and local communities. Lack of fodder is also the main reason for the decline of animal population. Many small farmers depend on tractors for cultivation and chemical fertilisers for manuring. Use of chemicals has not only resulted in compacting and crusting soils but has also destroyed soil organisms. Thus, farmers are forced to buy more and more external inputs, thus, becoming indebted.

The only solution to overcome this agriculture debacle, not only in India but also in the other countries is to adopt ecologically friendly farming with diversity of trees, animals and crops. We own a 4.2 acre irrigated land near Doddaballapura, in Bangalore Rural District in Karnataka State. We are producing food like cereals, beans, cooking oil, almost all species of vegetables and fruits, enough for 10 people for the whole year. This apart we also produce about 10,000 coconuts, 8 tons of sapota, 5 tons of papaya, 2 tons of avocado, 2 tonnes of soya bean, 10 tonnes of various seasonal vegetables and other fruits for the market. We have 8 cows, 12 goats and 25 native chickens. On the farm borders and edges, we have 300 various fodder, green manure and timber trees since 15 years. We are sure of getting an income of 30 lakh rupees by the sale of these timber trees during the next 15 years. This is apart from other benefits mentioned above. We have reared 200 fishes in our water storage tank which brings an annual income of Rs 6,000. Hence, a farm with bio-diversity of trees, animals, inter-cropped cropping system will provide food and financial security. Focus should therfore not be on monocropping that ultimately leads to debts and destruction to families and the soil.

■

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Capacity Building on Knowledge Management in CSOs

by K V S Prasad and T M Radha

Development organizations are deeply involved in generating lot of field knowledge. Often these learnings are not adequately captured and widely shared. Building necessary understanding, systems, processes and skill sets required for managing knowledge within institutions and sharing widely in public domain therefore becomes crucial. This requires integrating practices evolving from multiple disciplines, such as Management, Information systems and Communication.

Price: Rs. 100

The programme of Knowledge Management in Civil Societies is a new programme being initiated by LEISA India team through short duration Learning Workshops and long duration customised programmes. This document is the proceedings of the first workshop organised for CSOs during 22-26 April 2008.

If interested in the initiative / copies, please contact:

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NEW BOOKS

Protected landscapes and agrobiodiversity values by Thora Amend, Jessica Broan, Ashish Kothari, Adrian Phillips and Sue Stolton (eds.), 2008. ISBN 978-3-92506448-7. IUCN – The World Conservation Union, Rue Mauverny 28, Gland 1196, Switzerland, and GTZ, Postfach 5180, 65726 Eschborn, Germany.

As a collaborative effort between IUCN and GTZ, this is the first volume in a new series entitled "Values of protected landscapes and seascapes". The series will document the environmental, economic, social and cultural values of landscapes where communities thrive. This volume addresses agrobiodiversity through twelve case studies from around the world. It also provides a thorough overview of landscapes and biodiversity: their significance, current trends and threats, and actions which are now emerging to conserve diversity. Case studies focus on how protected landscapes contribute to conserving agrobiodiversity and related knowledge and practices. It is practical and easy-to-read. By presenting and discussing cases from different continents and contexts it shows the principles and variety of efforts in this field.

Research in action: Theories and practices for innovation and social change by Connie Almekinders, Leni Beukema and Coyan Tromp (eds.), 2009. ISBN 978-90-8686-087-6. Mansholt publication series, vol. 6. Wageningen Academic Publishers, P.O. Box 220, 6700 AE Wageningen, the Netherlands.

Does research only contribute to scientific knowledge? Or does it contribute to innovation and social change? Aimed at scholars, this book addresses the issues which determine the impact of research, and thus effectively contribute to change. With chapters describing and analysing practical cases from the Netherlands, South Africa and Mexico, the authors look at the possibilities and difficulties researchers face when trying to perform *research in action*. Put together, these cases show that *research in action* is both a dynamic research strategy and a scientific paradigm.

Responding to the global food crisis: Three perspectives by Joachim von Braun, Josette Sheeran and Namanga Ngongi, 2008. IFPRI 2007-2008 Annual Report Essays, International Food Policy Research Institute, 2033 K Street, NW Washington, DC 20006-1002, U.S.A. Downloadable from http://www.ifpri.org/pubs/books/ar2007/ar2007_essay.asp

These three essays, published as a collection in late 2008, provide different perspectives on the causes, as well as potential responses to the food crisis. Together they give a good overview of the recent global situation and are of interest to readers wanting a fuller and balanced picture of the food crisis. Full of examples from around the world, they discuss the effects of the crisis, how the situation has been tackled, and what more needs to be done in the future.

Revolutions in development inquiry by Robert Chambers, 2008, ISBN 978-184407-6-253, Earthscan, Dunstan House, 14a St. Cross Street, London EC1N 8XA, U.K. E-mail: earthinfo@earthscan.co.uk; http://www.earthscan.co.uk

Robert Chambers brings together some previously published texts with new material, which as a whole form a comprehensive review of development inquiry, spanning nearly 40 years. It is a look back over the changes in the approaches and methods used to find out about field conditions and community realities, while also looking forward at ideas such as participatory mapping and GIS, and the potential they have. Written in an informal style, it is also quite a personal account of experiencing these developments, focusing on the family of approaches including agroecosystem analysis, RRA, PRA and PLA. It is useful to have much of this material in one place, and will be an important reference for all categories of development practitioners.

Organic Farmers Speak On Economics and Beyond by Tej Partap and C S Vaidya, Rs. 200/= US $ 12, 2009, 184 pages, ICCOA, Westville Publishing House, No. 47, B-5, Paschim Vihar, New Delhi – 110 063, India, Telephone: +91-11-25284742, Telefax: +91-011-25267469 ISBN: 978-81-85873-46-6

The book "Organic Farmers Speak on Economics and Beyond" is the culmination of a first of its kind nation wise survey on the experiences and perceptions of organic farmers on important issues related to yield potential, economics, health benefits, response of crops to changing climate, market linkages and emerging marketing scenario. The analysis of experiences and perception of farmers not only dismisses many myths against organic agriculture and dispel fears of food insecurity but also strengthen the confidence and trust of practitioners. Some of the findings are on expected lines, but many of them are pleasant surprise.

Meticulously designed methodology and balanced interpretation of facts collected during the survey without any bias speak volumes about the intellectual honesty and sincerity of authors. The expert combination of an agricultural ecologist, Dr. Tej Partap and an economist, Dr. C S Vaidya shaped the treasure of information in establishing the fact that organic agriculture is the best option for small and marginal farmers of India.

With its wealth of information on organic practitioners' experiences and options it is a 'must read' document for policy planners, agribusiness professionals, scientists, promoters, critics and extension personnels.

Soil Not Oil: Environmental Justice in an Age of Climate Crisis by Vandana Shiva, 2008, Price:$15.00; Publisher: South End Press; ISBN: 9780896087828; No. of Pages: 160

With "Soil Not Oil," Vandana Shiva connects the dots between industrial agriculture and climate change. Shiva shows that a world beyond dependence on fossil fuels and globalization is both possible and necessary.

Condemning industrial agriculture as a recipe for ecological and economic disaster, Shiva's champion is the small, independent farm: their greater productivity, their greater potential for social justice as they put more resources into the hands of the poor, and the biodiversity that is inherent to the traditional farming practiced in small-scale agriculture. What we need most in a time of changing climates and millions hungry, she argues, is sustainable, biologically diverse farms that are more resistant to disease, drought, and flood. In her trademark style, she draws solutions to our world's most pressing problems on the head of a pin: "The solution to climate change," she observes, "and the solution to poverty are the same." Unwavering and truly visionary, "Soil Not Oil" proposes a solution based on self-organization, sustainability, and community rather than corporate power and profits.

Rainfed Agriculture Unlocking the Potential Comprehensive Assessment of Water in Agriculture Series: Vol 7. Edited by S P Wani, International J Röckstorm, T Oweis, Hardback January 2009, ISBN: 9781845933890, 320 pages , £85.00 / $170.00 / •135.00

This book is based on research undertaken by a team of leading scientists from 10 global organizations. Chapters consider the potential of rainfed agriculture on the basis of case studies for different regions in Asia and Africa with the aim to assess the need of water for achieving food security and reducing poverty. Yield gaps for major rainfed crops are analysed globally and possible ways and means including technological, social and institutional options to bridge the yield gaps are discussed in detail.

SOURCES

Towards food sovereignty: Reclaiming autonomous food systems by Michel Pimbert, 2009. IIED, Endsleigh Street, London WC1H 0DD, U.K. E-mail: info@iied.org Downloadable at http://www.iied.org/natural-resources/publications/towards-food-sovereignty-reclaiming-autonomous-food-systems

This book is based on the premise that while half of the world's working population is made up of farmers (most of them small-scale, producing for local markets), they are increasingly under pressure from large-scale corporations and unfavourable economic policies. This is an online book which is still under development. The first two parts are now available - Part I: Another world is possible for food and agriculture, and Part II: Local organisations at the heart of food sovereignty. These first parts therefore discuss diversity and the ecological basis of food and agriculture, the social and environmental costs of modern food systems, and the policy reversals needed to "democratise" food systems. It is colourful and very attractively presented, complete with links to video and audio material from farmers, fisherfolk, food workers and many others working to promote food sovereignty. It is freely downloadable; and further chapters will be posted on the website in 2009.

The governance of nature and the nature of governance: Policy that works for biodiversity and livelihoods by Krystyna Swiderska, Dilys Roe, Linda Siegele and Maryanne Grieg-Gran. IIED, International Institute for Environment and Development, 3 Endsleigh Street, London WC1H 0DD, U.K.

By looking in detail at the situation in Peru, India and Tanzania, the authors show the main reasons why the world is losing its biodiversity, and why, during the past 50 years, its ecosystem services have been significantly degraded. Their analysis focuses on these countries' governing systems, both at a local level and at a national level, pointing also at the ineffectiveness of the international governance framework. Not just highlighting difficulties and limitations, each chapter presents detailed recommendations, among which the authors include the need to improve policymaking processes, the importance of local rights, or the need to look at policy coherence.

Biodiversity and agriculture: Safeguarding biodiversity and securing food for the world by Secretariat of the Convention on Biological Diversity 2008. ISBN 978-92-9225-111-6. Convention on Biological Diversity, World Trade Centre, 413 St. Jacques Street, Suite 800, Montreal, Quebec, H2Y 1N9 Canada. Downloadable from http://www.cbd.int/doc/bioday/2008/ibd-2008-booklet-en.pdf

Produced in 2008 as part of celebrations for the annual International Day for Biological Diversity, this is a colourful 60-page booklet. The theme chosen this time was "Biodiversity and Agriculture" aiming at raising awareness of the importance of sustainable agriculture not only to preserve biodiversity, but also to feed the world, maintain sustainable agricultural livelihoods, and enhance human well-being. There are sections which clearly define biodiversity and agricultural biodiversity, going on to state the links between the two and why biodiversity is the "foundation" of agriculture. It continues by looking at current challenges and possible responses. The final chapter includes a list of suggestions for what individuals can do - specifically farmers, policy-makers and consumers. It is aimed at a wide audience as it is very clearly expressed, concise and well-organised, with many sub-headings and boxes for easy reference and reading.

Conserving and valuing ecosystem services and biodiversity: Economic, institutional and social challenges by K. N. Ninan (ed.), 2008. ISBN 978-184-407651-2. Earthscan, Dunstan House, 14a St. Cross Street, London EC1N 8XA, U.K. E-mail: earthinfo@earthscan.co.uk ; http://www.earthscan.co.uk

This new book offers a comprehensive look at the difficulties faced in conserving biodiversity. It also covers valuation of ecosystem services, which has become a hot topic in development and environmental economics. Addressing economic, social and institutional issues in biodiversity conservation, chapters written by leading contributors refer to ecosystems including tropical forests, marine areas, wetlands and agricultural landscapes. Case studies drawn from the U.K., U.S.A., Europe and Australia, as well as from India, Africa and South America, cover issues such as governance, intellectual property rights and protection of traditional knowledge. This wide-ranging book will be interesting to those working in agricultural development, biodiversity conservation, as well as researchers, policy-makers or practitioners.

Farming systems and poverty: Improving farmers' livelihoods in a changing world by John Dixon, Aidan Gulliver and David Gibbon, 2001. ISBN 978-92-5-104627-2. FAO, Viale della Terme di Caracalla, 00100, Rome, Italy and World Bank, 1818 H Street, N.W., Washington, D.C., 20433, U.S.A. The book is downloadable from: http://www.fao.org/farmingsystems

While some would say that the farming systems approach has been surpassed with new developments in thinking (such as the sustainable livelihoods approach), the basic concepts behind it are useful and still hold. The authors argue that analysis of farming systems can assist in identifying priorities for reducing poverty and hunger, so forming the basis for creating dynamic rural communities. The book begins with an overview of the concept of farming systems and its future relevance. It then outlines and analyses the main farming systems of six major developing regions of the world. Twenty-five systems are described, including, for example, tree-crop farming systems in sub-Saharan Africa and high altitude mixed farming systems in Latin America. It concludes with chapters looking at the challenges and crosscutting priorities, such as the greater emphasis needed on sustainable resource management, enhancement of agricultural information and supporting small rural enterprises.

Conservation and sustainable use of agricultural biodiversity: A sourcebook by CIP-UPWARD, 2003. ISBN 978-971-614-021-7. International Potato Center, Users' Perspectives with Agricultural Research and Development, c/o IRRI DAPO Box 7777, Metro Manila, Philippines. E-mail: cip-manila@cgiar.org

The main objective of this sourcebook is to encourage the management of agricultural biodiversity resources within existing landscapes and ecosystems, in support of the livelihoods of farmers, fishers and livestock keepers. It is organised in three volumes, with over 75 articles in total. The articles were written by practitioners, researchers, and academics from all over the world, using clear and easily understandable language, with many illustrations. This is a useful tool for rural development practitioners and local administrators, as well as for trainers and educationalists. Free use of the material is encouraged, provided the source and authors are duly acknowledged.

Small farms as a planetary ecological asset: Five key reasons why we should support the revitalisation of small farms in the global South by Miguel A. Altieri, 2008. ISBN 978-983-2729-56-3. TWN Environment & Development Series no. 7, Third World Network, 131 Jalan Macalister, 10400 Penang, Malaysia. E-mail: twnet@po.jaring.my

In a clear language, Miguel Altieri outlines here five reasons why he believes small, biodiverse, agroecologically managed farms in the global South are the only viable form of agriculture that will feed the world. Against a backdrop of rising production costs and food prices, he writes in favour of maintaining and revitalising small-scale farms and farming families. The conservation and promotion of agricultural biodiversity forms the basis for some of his arguments, which are

backed up with a variety of research and data. The booklet gives food for thought to all working in small scale agricultural development.

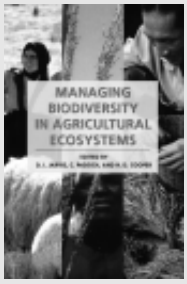
Affirming life and diversity: Rural images and voices on food sovereignty in south India by Community Media Trust, PV Satheesh and Michel Pimbert, 2008, ISBN 978-1-84369-674-2. IIED, 3 Endsleigh Street, London WC1H 0DD, U.K., and Deccan Development Society, 101, Kishan Residency, Road No 5, Begumpet, Hyderabad - 500 016, Andhra Pradesh, India. E-mail: hyd1_ddshyd@sancharnet.in Downloadable at http://www.iied.org/pubs/pdfs/14556IIED.pdf

Together with IIED, the Community Media Trust (CMT) of the Deccan Development Society, India, co-facilitated a group of non-literate women in Andhra Pradesh to produce twelve videos covering their perceptions on food systems, food sovereignty, seeds, agriculture and local markets. These films are summarised in this book and included on a set of four DVDs. The book also describes the research process behind making these participatory films, as well as the research ethics agreed. The videos serve to highlight the voices and priorities of women who often do not get heard. The publication also shows the women's ability in presenting their ideas and situation through video. The videos in particular are insightful and offer many lessons to scientists, policy-makers and development practitioners.

Linking conservation and poverty reduction: Landscapes, people and power by Robert Fisher, Stewart Maginnis, William Jackson, Edmund Barrow and Sally Jeanrenaud with Andrew Ingles, Richard Friend, Rati Mehrotra, Taghi Farvar, Michelle Laurie and Gonzalo Oviedo, 2008, ISBN 978-184-407636-9. IUCN – The World Conservation Union, Rue Mauverny 28, Gland 1196, Switzerland, and Earthscan, Dunstan House, 14a St. Cross Street, London EC1N 8XA, U.K. E-mail: earthinfo@earthscan.co.uk ; http://www.earthscan.co.uk

This is a fully updated and revised edition of "Poverty and conservation: Landscapes, people and power", published by IUCN in 2005. It includes recent developments in theory and practice, with case studies from Francophone Africa and Latin America. It links poverty to conservation, showing how livelihoods of the rural poor are so closely related to sustainable use of biological diversity, that the two issues should be tackled together, through an integrated approach. The authors call for "the reinvigoration of sustainable development", focusing on the complex links between poverty reduction, economic development and biodiversity conservation. The final section presents a summary of the integrated approach and identifies some of the challenges involved in efforts to combine conservation and poverty reduction.

Managing biodiversity in agricultural ecosystems by Devra I. Jarvis, Christine Padoch and H. David Cooper, 2006. ISBN 978-0-231-13648-8. Bioversity International / Columbia University Press, New York, U.S.A.



With chapters contributed by a vast array of experts, this book looks at how farmers manage, maintain, and benefit from biodiversity. It presents the most recent research and developments in the maintenance of local diversity at the genetic, species, and ecosystem levels. The chapters are detailed and well-referenced, covering farmer management practices for crop, livestock, aquatic, and associated diversity (such as pollinators and soil micro-organisms) in agricultural ecosystems. Combining the thinking of social and biological scientists, the authors examine the potential role of diversity in minimising pests and diseases. The many case studies show how farmers have used alternative approaches to managing biodiversity to enhance the stability, resilience, and productivity of their farms. These point the way towards improved biodiversity on a global scale.

National biodiversity action plan 2008 Government Of India, Ministry of Environment and Forests, November 2008, http://envfor.nic.in. F.No. J-22018/25/29/99-CS (BC)-Vol.(VI)

The National Biodiversity Action Plan approved in November 2008 to augment natural resource base and its sustainable utilisation. The Plan draws from the principles of National Environment Policy, incorporates suggestions made by a consultative committee and proposes to design actions based on the assessment of current and future needs of conservation and sustainable utilization.

The process of preparing the National Biodiversity Action Plan (NBAP) for India was carried out by the Ministry of Environment and Forests involving wide consultations and planning with various stakeholders across the country, including an externally aided project on 'National Biodiversity Strategy and Action Plan (NBSAP). On the basis of these action plans, a final technical report of NBSAP was prepared under the project. This NBAP document is broadly based on the evaluation of existing legislations, regulatory systems, implementation mechanisms, existing strategies, plans and programmes, using the report of NBSAP project as one of the inputs. It proposes to design actions based on the assessment of current and future needs of conservation and sustainable utilization, and of physical and fiscal instruments, with particular reference to implications and impact of such instruments on short and long term basis. Considering the multidisciplinary nature of biodiversity, the actions identified in the NBAP are aimed towards integration of the three objectives of the CBD into relevant sectoral or cross-sectoral plans, programmes and policies.

Sustainable Agroecosystem Management : Integrating Ecology, Economics, and Society (Advances in Agroecology) (Hardcover) by Patrick J. Bohlen, Gar House, 328 pages, 2009, Price: $99.95, ISBN: 9781420052145 ISBN 10: 1420052144, Publication Date: March 24, 2009

Sustainable management of agroecosystems in the 21st century faces unprecedented challenges. Protecting the environment while feeding a burgeoning population that could reach nine billion by mid-century, preserving the world's biodiversity, and sustaining agriculture in an increasingly urban world is a massive undertaking. Avoiding simple prescriptions for the application of ecological principles to agriculture, the book emphasizes the continued centrality of the ecosystem perspective, and the need to integrate ecological, economic, and social considerations in agroecosystem science and management.

With contributions from distinguished leaders in the field of sustainable agriculture, this authoritative book first delineates the present and future challenges agroecosystems face. Through a variety of case studies with global applications, the text makes it abundantly clear that purely technological approaches are insufficient for solving the food systems problems of the future. It explores practical innovative strategies, policies, and research needs necessary to develop management approaches that emphasize whole system productivity, diversify agricultural operations, and sustain multiple functions, including ecological integrity.

The INFONET-BioVision Farmer Information Platform
http://www.infonet-biovision.org

This large website provides a wealth of information on organic agriculture and crop husbandry, ecological prevention and the control of plant, human and animal pests and diseases. Focusing on ecological agriculture, it describes simple and environmentally safe technologies to improve your life and generate income while at the same time protecting the environment and the natural resources. For example, the site describes 44 common crops in detail, and for each crop gives agronomic information, descriptions of pests and diseases, and a list of links to other sources of information. Contributions come from farmer groups, local experts and international scientists. With a major emphasis on Africa, the site aims to make this information available through other means as well (so an "offline version" can be easily downloaded). This is a useful resource for those seeking practical information about ecological development in Africa.

Globally Important Agricultural Heritage Systems
http://www.fao.org/sd/giahs
FAO, Viale della Terme di Caracalla, 00100, Rome, Italy.
E-mail: giahs-secretariat@fao.org

This is the homepage of the Globally Important Agricultural Heritage Systems (GIAHS) project, currently being implemented by FAO in different countries. This project aims to establish the basis for the global recognition, conservation and sustainable management of such systems and their associated landscapes, biodiversity, knowledge systems and cultures. This website contains clear descriptions of some of the systems identified in different parts of the world, such as rice/fish agriculture in China and the oases of Tunisia, Algeria and Morocco. It also has many project documents available, links to other sites and lots of background information, making it an interesting place for anyone wanting to learn about such agricultural systems.

Agroecology.org
http://www.agroecology.org

Presented as an information resource for developing sustainable food systems, this site is put together by the Agroecology Research Group at UCSC, the University of California at Santa Cruz. This is a group of graduate and undergraduate students, research associates and postdoctoral researchers guided by Stephen Gliessman. The site includes a large collection of case studies from all over the world, together with a series of pages with theoretical content (which includes a section presenting an "ecological definition of sustainable agriculture", a list of principles of agroecology and sustainability, and a complete glossary). It has links to many other organisations, and also information about the events organised by the group, such as the upcoming course "Participatory Action Research in agroecology to support sustainable food systems", to be held in Vermont, U.S.A., in June 2009.

The Coalition to Diversify Income from Underused Crops (CoDI)
http://codi-asia.net
c/o International Centre for Underutilised Crops, P.O. Box 2075, Colombo, Sri Lanka

CoDI is a group of organisations in India and Vietnam led by the International Centre for Underutilised Crops. This website describes their activities, all of which are aimed at increasing diversity on farms, linking small farmers to markets and improving processing, packaging and marketing skills. The coalition will provide community services to help disadvantaged people in India and Vietnam generate sustainable incomes. Their activities include "Food Processing Parks", "Village Crop Fairs" and "Knowledge Fairs". It also contains useful information about underused crops in the region, and project descriptions and analyses.

Planet Diversity - World Congress on the Future of Food and Agriculture
http://www.planet-diversity.org/storiesandvideos.html

The Planet Diversity Congress was held in May 2008, and attended by over 700 people from 100 nations. Summaries of all the workshops held are available online, as well as PDF files and videos of many of the presentations and speeches. This specific section has additional stories from all over the world, covering many topics. They are often quite practical, describing experiences and activities. With so many documents available, this website is a very comprehensive source of up-to-date information about diversity, coming from researchers, farmers, practitioners and academics alike.

Sustaining local food systems, agricultural biodiversity and livelihoods
http://www.diversefoodsystems.org
IIED, 3 Endsleigh Street, London WC1H 0DD, U.K.

This is the site of a research project carried out by the International Institute for Environment and Development. As a result of the project following "an international, action-oriented, interdisciplinary and case study approach", the site has a lot of information about key concepts in local food systems, biodiversity and livelihoods. It also describes its work in India, Indonesia, Peru and Iran, with cases than analyse the linkages between social, economic and ecological systems. Links to publications, background documents and other sections of IIED are also given.

Agricultural Biodiversity Weblog
http://agro.biodiver.se

Run by Luigi Guarino and Jeremy Cherfas, the aim of this weblog is to collect information from the internet that relates to agricultural biodiversity. As this is a broad topic, the two bloggers have much to choose from. Topics covered include nutrition, genetic diversity, livestock and many more. Blog entries range from news items, newspaper articles, and random thoughts, to updates from organisations working with and promoting biodiversity. Readers are encouraged to comment on blog entries, and also to contribute entries. There are many links to related websites and readers can subscribe to the blog with RSS or email. It is written in a very informal manner, and is peppered with humour, which makes it enjoyable to read and return to.

Convention on Biological Diversity
http://www.cbd.int

The website of the Convention on Biological Diversity is a large resource, containing information about the convention itself and the Protocol on Biosafety. It describes various programmes, including Agricultural Biodiversity, Island Biodiversity and Mountain Biodiversity for example, each complete with updates, background information, activities and links. From the homepage you can sign up to receive various e-newsletters, and there is also a link to The Green Wave (http://greenwave.cbd.int), a global biodiversity campaign to educate children and youth about biodiversity.

Living the sustainable life: Managing a dryland family farm

In 1999, Aspen and David Edge bought Semilla Besada, a 12 hectare farm in southern Spain, with the intention of re-establishing its family farming tradition. They faced various challenges: the dryland environment, lack of markets and little social support. However, through using various management and design tools, encouraging diversity on the land and sustainably managing the grazing animals, the family is increasingly able to sustain itself.

Aspen Edge

Although it had previously fed a family of 10, by 1999 *Semilla Besada* had not been farmed for 20 years. With irrigation, the previous family had grown vetch, alfalfa, wheat, rye, lentils and chick peas, and a wide range of vegetables. They also had three sheep, chickens, two pigs, beehives and a cow. When we took the farm over in 1999, it no longer provided a living. The stone terraces that created the space on which to grow food had collapsed. The mountainside that had once been home to some 50 families, now only supported three: all of these were goat farmers. The remainder had either left for work in the cities, or joined the lucrative, but unsustainable, greenhouse vegetable production system on the eastern coast of the country.

Together with my husband and son, I live and work at *Semilla Besada*, a 12 hectare family farm set at an altitude of 1300 m in the Sierra Nevada mountains, in the province of Granada, southern Spain. The landscape is characterised by short-lived woody perennial shrubs and indigenous oaks. Temperatures can fall to -15oC and rise to 40oC, with an average of 540 mm of annual rain. Although there are four distinct seasons, there is low year-round humidity and a summer drought which can last for six months. This combination of climatic factors classifies it as a brittle or dryland area. The property has a 1½ hour weekly irrigation water right.

Inherited challenges

Apart from the climatic difficulties, *Semilla Besada* faced the following challenges:

- Increasing degradation of the landscape encouraged by agricultural subsidies that resulted in overstocking;
- A minimally productive landscape, resulting from lack of management and loss of fertility;
- No source of sustainably managed seed;
- Lack of local markets, due to inability to compete with production farming prices and the non-existence of niche markets;
- Poor social support due to the collapse of family farming in the area; and
- Hardship caused by inappropriate government regulation of food production on small-scale family farms.

Photo: Aspen Edge

Volunteers come to learn about dryland management while making a valuable contribution to the farm.

We bought the farm in 1999, intending to re-establish its family farming tradition. For many years, we had recognised a desire to lead a different way of life; one that represented a better balance between the environment and human needs. We realised that while the West had enjoyed an unparalleled boom in terms of wealth, material goods and choice, part of the price being paid was the increasing depletion of the earth's natural resources. Our lifetimes' experience of both business and the environment convinced us of several significant factors:

- The dubious merits of the existing conventional economic model;
- The need to design sustainable economic models;
- The absolute necessity to prioritise restoration and conservation of natural resources; and
- The need for individual action, rather than reliance on governments or government agencies to lead the way, due to the urgency of the situation.

We felt that by purchasing our own land, we would be in a much better position to address the above challenges. We would also be able to live a more sustainable life, whilst restoring and conserving the natural resources upon which that life depended.

Holistic Management

This a decision-making framework that helps people create the quality of life that they want, whilst ensuring social, economic and environmental sustainability. It has a track record in three continents of using grazing animals in a way that not only does not degrade the landscape, but actually reverses desertification.

For further information: Holistic Management International, 1010 Tijeras Ave. NW, Albuquerque, NM 87102, U.S.A. http://www.holisticmanagement.org

The first four years

We brought with us a lifetime's experience of growing our own food, as well as four years' permaculture design experience within both a northern temperate and a tropical climate. We used 40% of our capital to buy the land, leaving 60% for its development. This included enough to support our family of three for a 10 year period – the time we believed it would take to develop a sustainable living from the farm.

After a year of observation to determine existing plant infrastructure, climatic conditions, soil fertility and design parameters, we began to initiate the classic multi-layered, perennial food production system beloved of permaculture designers. However, after four years, we had to acknowledge that we were beaten! The landscape was not responding as we had expected: there was less plant diversity and more bare soil than when we arrived, and definitely no sustainable livelihood.

It was then that we came across the work of Allan Savory. Through that we realised that we were missing a crucial piece of knowledge: the difference between brittle and non-brittle environments, and how that affected farm design and management. I undertook training in Holistic Management, the name of the framework that had evolved from Savory's work. I discovered that it offered much more than environmental insights: it would enable David and I to make personal, land management and financial decisions that would have a positive impact on land health and productivity. The framework also provided skills to develop plans and activities in a way that would move consistently towards social, economic and environmental sustainability, as well as providing effective techniques for reversing desertification in the area.

Getting down to it – planting vegetables to contribute to diversity, sustainability and income.

Photo: Aspen Edge

Whole farm planning, monitoring and controlling

We created a management plan to cater for the short, medium and long-term sustainable development of *Semilla Besada*. We drafted a statement of what quality of life we wanted, what we needed to do to achieve it, and how that could be sustained indefinitely. This statement included social, economic and environmental aspirations for the project as a whole. It also provided the foundation for drafting the policies, strategies and objectives for each year. We created a whole-farm financial plan which outlined where resources would be allocated, ensured that expenses were capped, profit was planned and that no debt arose.

Having outlined the parameters of the farm management, it was then possible to begin designing the landscape. The insights of Holistic Management were crucial here, as they explained why dryland environments performed as they did, and how grazing animals could be used sustainably. The design drew on the following permaculture principles, in addition to those that underpinned the Holistic Management framework:

- whole systems view
- elimination of waste
- building diversity
- use of sensitive solutions
- design from the big picture to the detail
- use of renewable resources and services
- integrate human psychology.

The farm was then designed to ensure that the areas that were worked most often were nearest to the farmhouse, that all water was recycled for irrigation, that all human and animal waste was used to build soil fertility, that solar and wind power were installed to provide for energy to run office and household equipment, that solar ovens were installed to mitigate the use of bottled gas, and that a tree-planting plan was initiated to provide firewood for heating in the future.

Holistic Management offered tools to ensure that we stayed on track, and could deal with problems in a timely way. It also provided a system for monitoring what was happening on the land to ensure that the health of the ecosystem was not compromised, and if it was, what needed to be done to change that. It also ensured that every decision was leading towards social, economic and environmental (known as "triple-bottom-line") sustainability.

Tangible results

After 10 years, we have built an infrastructure of vines and mixed fruit and nut trees which currently comprises 50 fodder trees, 105 fruiting shrubs, 200 fruiting plants, 90 perennial vegetables, 100 grape vines, 100 mixed fruit and nut trees, six vegetable growing areas, beehives, a warren of 20 mixed-breed rabbits, a flock of 30 local rare-breed Andalusian Blue chickens, and nine mixed-breed Milking/Awassi sheep. The farm supports a group of four, consisting of myself and David, our son, Samuel, and a year-round volunteer or intern.

In addition, we have addressed the challenges we inherited by:

- using holistically-managed sheep. This has reversed the degradation of the existing perennial grasses within a 2 hectare fenced area, which is in stark contrast to the unmanaged area beyond;

- increasing food security. Through improved soil fertility and structure, growing diverse dryland-adapted species of trees, shrubs, plants and vegetables, and saving locally-adapted heritage seeds;
- developing contacts with conservation agencies: especially those that already work with grazing animals to mitigate bushfire hazards in order to foster the possibility of *Semilla Besada* becoming a funded research site;
- developing educational opportunities in Holistic Management and dryland design and management. We also want to allow greater public access to *Semilla Besada* as a model of what is possible in a dryland environment;
- developing the future potential to respond to arising niche markets. This will be through creating solar drying facilities to produce organic dried fruit, herbs and vegetables; a milking breed of sheep to produce organic yoghurt and cheese; and a plant nursery for generating dryland-adapted trees, shrubs, plants and vegetables;
- publishing material highlighting the fact that grazing animals can be used in a managed way to restore and improve perennial grasslands, which is of pivotal importance to existing goat farmers;
- developing contacts with local ex-farming families to safeguard traditional knowledge and skills as well as heritage seeds; and
- creating a network of direct farm clients who are prepared to support the work of *Semilla Besada*. We have also initiated a seed library to encourage exchange of dryland-adapted heirloom seeds.

Added to this has been the generation of a sustainable livelihood which is comprised of:

- 80% production of its own organic food, with a market value of h2000
- 95% production of its own energy, with a market value of h2500
- 97% generation of its own organic seeds, with a market value of h400
- 11% income from direct donations from the public
- 57% income from educational seminars
- 5% income from educational publications
- 25% income from sustainable walking tourism (to be phased out in 3 years, in favour of the more sustainable option of education).

Safeguarding the future

With the encouragement of production farming, and 90% of Granada's income coming from tourism, the management of this area continues to exacerbate environmental degradation. Family farm initiatives, such as *Semilla Besada*, play an essential role in modelling a way forward which enhances environmental health and provides food security and a sustainable livelihood. When priority is given to sustainability, then it is possible to build a stable local infrastructure which is not at the mercy of fluctuating global scenarios, and can support a family for generations to come.

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The brittle landscape poses many new challenges in designing and managing a sustainable system.

Photo: Aspen Edge

European ban on pesticides opens door to alternative approaches

The European Parliament voted to ban 22 pesticides to protect the health of consumers and farmers. Besides pesticide companies, large-scale farmers in Europe are protesting against the ban because they fear their yields and incomes will fall. Others see it as an important stimulus to develop alternative pest management methods, building on thousands of years of farming experience.

Industry representatives and some farmers in Europe responded negatively to the decision of the European Parliament because they fear that the yields and quality of their major vegetable and fruit commodities will go down. However, according to Stephen Sherwood, an organic farmer who works for the NGO World Neighbors, and who has worked on these issues in Latin America for over 20 years, history does not back up this concern: "I have heard those same arguments for two decades. The agrochemical industry likes to promote the myth that their products are essential for food security. I know of no examples where removal of a (pesticide) product from the market led to production declines. In all cases, farmers adapted and found new alternatives, including non-chemical alternatives. We should remember that in most parts of the world, chemical-free farming outlives the industry's products by millenia." Sherwood considers the most dramatic example of this to be when the Indonesian government reduced subsidies on pesticides as well as banning 57 pesticides in 1986. According to research on the government's wider strategy of integrated pest management (IPM) conducted by Peter Kenmore (Deputy Director of the FAO's Plant Production and Protection Division), rice production actually increased by 12 percent within a few years of pesticide reduction.

European farmers also worry that they will not be able to compete with lower-priced imports from countries outside the EU, where farmers can still use the pesticides. This fear is negated on the EU website, however, as: "food imports are already checked by the EU for pesticide residue levels," which would now include the new pesticides as well.

The EU proposal

The European Parliament voted in January 2009 to tighten the use of pesticides in agriculture. All of the EU's 27 member states are expected to support the decision. The proposed legislation is directed at 22 chemicals that are considered most hazardous to human health, including links to cancer, damage to the reproductive and nervous systems, and disruption to hormones. It restricts the spraying of crops –banning wholesale aerial crop-spraying– and bans the use of pesticides near schools, parks and hospitals. Buffer zones would also be mandatory to protect aquatic environments and drinking water from pesticides. The tighter rules aim to halve toxic substances on plants by 2013.

See more at: http://www.europarl.europa.eu

Photo: S Jayaraj

Cotton farmers in India studying about insects as part of a course on IPM, an alternative approach to pest control promoted by the EU in its directive accompanying the ban.

Room for alternatives in the EU…

Those supporting the ban point to the opportunity that this new law will bring to the research community to develop safer alternatives. The EU actually promotes integrated pest management within a directive on the sustainable use of pesticides (that accompanies the proposed legislation), as a viable way of maintaining production and controlling pests through agroecological and cultural methods. However, some may find the EU ruling too soft as it gives pesticide manufacturers five years to adjust their products; also, if no alternative product exists in 2013, farmers may continue to use them for another five years.

…and abroad

"It's about time this ban takes place!" says Fábio Kessler Dal Soglio, from the department of Rural Studies at the Federal University of Río Grande do Sul in Brazil. Dal Soglio is not only a professor, but he also leads the development of a network working to eliminate pesticide use in Brazil, *Rede Brasileira contra os Agrotóxicos*. Composed of health, consumer, environmental and agroecological farmer groups, this network will officially be launched at the same time as a national meeting called by the National Health Surveillance Agency on pesticide use in March. According to Dal Soglio, "The EU vote has finally convinced the Brazilian government to re-evaluate pesticide use in Brazil, including these same 22 pesticides – even while pesticide companies have tried to block this move." Dal Soglio is not worried that lower yields will result. "New solutions will be offered through the use of agroecological methods." (MS)

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