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LEISA

Magazine on Low External Input and Sustainable Agriculture

Ecological pest management

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Cover photo
Farmers look for insects in a pheromone trap in a groundnut field. Netharanahalli village, Bellary, Karnataka (India). Photo: S. Jayaraj.

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Push-Pull is a strategy used for managing Striga and stemborers in maize. It has had considerable success in recent years, increasing yields in many farms, while also reducing soil erosion, enhancing biodiversity and improving food security. It has been adopted by 10 000 households in East Africa, disseminated through mass media, field days, shows and demonstrations. This article describes how Farmer Field Schools are increasingly being used to promote this strategy further throughout the region, and how farmers are actively facilitating this approach.

Faced with dropping rice yields due to stemborers, some women farmers in Kepanjen subdistrict, Java, Indonesia, asked local extension workers and NGOs for advice. This is how the women farmers' group was started. Since then, they have held weekly meetings in their fields, with extension workers, to discuss their farming problems and how to deal with them. The women's group now conducts experiments on pest management, among many other topics. As a result, yields have recovered. At the same time, the members of this group have become confident enough to act as resource persons for other groups.

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 basis 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 an environment conducive for its further development. LEISA is a concept, an approach and a political message.

ILEIA is the Centre for Information on Low External Input and Sustainable Agriculture. ILEIA seeks to promote the adoption of LEISA through the LEISA magazines and other publications. It also maintains a specialised information database and an informative and interactive website on LEISA (**www.leisa.info**). The website provides access to many other sources of information on the development of sustainable agriculture.

16 Plant clinics for healthy crops

Jeffery Bentley, Eric Boa, Solveig Danielsen and A.K.M. Zakaria

At a plant clinic, any member of the community can get a diagnosis and some advice. A network of such clinics is emerging in countries as diverse as Bolivia, Nicaragua and Bangladesh. The "plant doctors" are local extension workers or farmers; its clients are all those interested in discovering what is wrong with their crops. Drawing on examples from these three countries, this article presents the plant clinic strategy, describes the possibilities it brings and also gives tips on how you could initiate a local plant clinic.

18 Rats: An ecologically-based approach for managing a global problem

Steven R. Belmain

Many people have problems with pest rodents. Rats damage our crops and possessions and spread dangerous diseases to people and livestock. While this can be a difficult problem to tackle, experience has shown that with the right knowledge and tools it is possible to sustainably reduce pest rodent populations. A number of research and extension institutions have recently been collaborating with farming communities in Asia and Africa to develop effective rodent management strategies. Here you can read about how communities in Bangladesh have managed to dramatically reduce rat populations, and see the difference it has made.

DEAR READERS

This issue looks at one of the most pressing problems which farmers all over the world face: the presence of pests and diseases in their fields. Once again, we received many contributions, and the task of selecting the articles presented here was not an easy one. It has been very interesting to see, however, that so many experiences are taking place, and that so many farmers are benefiting, in terms of yields and incomes, from a LEISA approach to agriculture. Complementing this issue, readers may be interested to look back at older issues of *LEISA Magazine* looking at pest management: please read Vol. 1, No. 6, ("Pest management: Do small farmers have effective alternatives to chemical pesticides") and Vol. 13, No. 4 ("Fighting back with IPM"). Both are available on our website, as PDF and as HTML files.

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The Editors

Ecological pest management

Editorial

More than twenty years ago, one of the first newsletters we published focused on the dangers of pesticides, highlighting the fact that its use was spreading rapidly. The negative effects of pesticides were already being seen: many pest species were becoming resistant (thus needing heavier dosages and more frequent applications), secondary pests were emerging, the number of acute poisonings was very high, and the overall effect of pesticides in the ecosystem was becoming apparent. This clearly showed the need for "alternative methods" and for a "different pest management system" for worldwide agriculture. As we mentioned then, rather than relying on external inputs, farmers needed to look at pests and diseases as part of the ecosystem, and focus on prevention through the diversification of production systems. A major component of managing pests and diseases was the relationship between pest incidence, soil fertility and soil organic matter content: "because of bad soil condition and consequent bad growth, plants become more susceptible to pest attacks".

Ten years later, in 1997, we looked at these issues again, mentioning the importance of substituting external inputs for labour, management skills and knowledge. These were the basic elements of "Integrated Pest Management", an attractive approach for small-scale farmers especially. Originally designed as a technical approach to reduce the number of pesticide applications, IPM developed into a comprehensive methodology, based on farmers' better understanding of their own agro-ecosystems. IPM first considered the integration of control methods and target pests as a combination of biological control methods, host plant resistance, cultural control and selective chemical control. When it was realised that many agricultural practices influence pest incidence, farm management was also added to the equation as an important part of an IPM approach, together with management of natural resources. Gradually, social aspects were also included, paying attention to women's roles in pest and disease management, to the role of local organisations and to the importance of indigenous knowledge in the process of developing the necessary skills and confidence to make ecologically sound and cost-effective decisions on crop health.

IPM has been strongly linked to processes which build on farmers' ability to learn, experiment and take appropriate decisions. Leaving behind more traditional "technology transfer" extension methods, IPM projects have developed around the Farmer Field School approach. Implemented first in Asia and then all over the world, Farmer Field Schools have proven to be a very effective tool for encouraging farmers to look for solutions to their problems, gaining the knowledge and the practical experience necessary to manage their farms successfully. IPM has therefore been built around farmers' own learning processes.

The situation today

As our magazine has regularly shown, there have been many positive pest management experiences during these last 20 years. As a result of a comprehensive IPM approach, farmers have been able to increase their yields and incomes. Many examples have shown a reduced reliance on pesticides, effectively diminishing their use. Lobbying and advocacy actions have led to new rules and regulations in many countries, forbidding the commercialisation and use of the most toxic products, and at the same time greatly increasing the awareness of farmers and consumers. But the problems persist, and these are not limited to large scale farmers or to intensive agriculture situations.

On a daily basis, small scale farmers in different parts of the world still experience many of the difficulties reported twenty years ago. Although reliable statistics are difficult to find, the impact of pests and diseases in worldwide agriculture is considerable, lowering yields and overall production, resulting in losses that are equivalent to millions of dollars. These losses are not only unpredictable; they are also greater in fragile ecosystems.

Furthermore, the most common and widely available "solution" of using pesticides has only made problems worse. Farmer suicides as a result of pesticide debt traps have become common in countries as different as India and Ecuador. And pesticide poisoning is a common story, having reached endemic proportions in many countries. Farmers and labourers who are regularly in contact with pesticides suffer from severe health problems, seriously affecting them and their families. In Peru's village of Tauccamarca, as in many rural areas in Africa, Asia and Latin America, accidental intoxications have resulted in the death of children and innocent people. Indiscriminate use of pesticides has also resulted in the contamination of soils and groundwater, leading to the disappearance of fish and birds. Because of the lack of regulations, or of the difficulties in effectively enforcing them, these problems are greater in the rural areas of the non-industrialised world.

Ecological Pest Management

IPM has had many successes, but the magnitude of the problem which farmers currently face forces us to look once again at pests and diseases and at their management. While it may be necessary to critically assess the extension methods followed during these last two decades, it seems equally relevant to stress and emphasise again one of the basic ideas behind the "different pest management system" which we called for more than twenty years ago: that pests and diseases are not an isolated part of agriculture, but rather a symptom of a broader problem, and need thus to be seen –and managed– accordingly.

Not surprisingly, this is known and recognised by many farmers. A few years ago in Tamil Nadu (India), at a meeting where farmers, NGO officials and government extension workers got together to discuss the most pressing problems in small scale farming, pests and diseases came out as the most important problem to be addressed. Farmers mentioned that the pesticides they used were increasingly ineffective, so that therefore they had to use more and more of them. Expressing the views of most participants, one farmer stood up to say that "… we can try to tackle these pest problems, but we must understand that a plant suffering from pest problems is like a diabetes patient suffering from skin boils. The boils are a symptom of a deeper problem in the human body, and so are pests in the paddy crop a symptom of a deeper level health problem. We need to tackle the symptom first and then go deeper to address the cause of the problem. We have to look at the paddy plants and the soil and at everything around".

His views reflect the need for an ecological perspective when addressing the presence of pests and diseases in agriculture. Building on the wide range of experiences gained with IPM during the last two decades, an ecological pest management approach is one which focuses on managing pests as part of a wider ecosystem. As such, EPM is based on:

(a) Minimising the disturbances which are caused by agriculture
In whichever setting it is practised, agriculture will always cause

disturbances and change the ecosystem, and one species (the crop) will nearly always dominate other plant species. These disturbances, however, need to be as small as possible. As Lanting (p. 6) points out, a successful pest management strategy is based on mimicking nature, redesigning a farm so that it resembles a complex ecosystem. This will mean maximising a farm's positive ecological processes (such as nitrogen fixation, nutrient mineralisation); while at the same time minimising undesirable processes such as nutrient loss or erosion. In many cases it may be convenient to reduce tillage and thus achieve minimal soil disturbance; in many others it will be necessary to include perennial species and enhance a farm's overall diversity. The interaction of different species, as Amudavi *et al.* (p. 8) show, can have interesting results, contributing to the system's overall resilience.

(b) Decreasing plants' vulnerability
Not all plants are equally susceptible to pests and diseases. This is even true for plants of the same species and variety: field observations show that pests prefer to attack plants under stress. Current studies, such as those falling under the theory known as trophosiosis, talk of a plant's "internal balance", directly related to its nutritional state. The best way to prevent the attack of pests and diseases is thus by providing a healthy and balanced environment and food supply. As Guazzelli *et al.* show (p. 14), there are many factors which can affect a plant's internal balance and thus lessen or increase its susceptibility to pest and disease attacks. These are related to the plant itself (such as adaptation to the local climate or its age) or to the environment (climate, light, temperature, humidity, wind). Plant vulnerability is also related to the different management practices which regularly take place in a farm, such as spacing, tilling, pruning, or the time of planting.

(c) Understanding pests and acting accordingly
The interactions between the components of an ecosystem vary greatly, and are specific to every location. In pest and disease management, one of the main considerations is the way the pest species behave: some show abilities to reproduce often and disperse widely, others are able to withstand competition or adverse conditions. To "know your enemy" (Belmain, p. 18) is thus a key strategy in every pest management approach. This knowledge needs then to be translated into action, considering, for example, the release of beneficial insects on a particular moment, adding bird nesting sites to a farm, or changing the sowing time of certain crops.

These principles are clearly visible in many traditional low input agricultural systems, where ecological principles form the basis for all pest management strategies. In brief, these refer to working with nature, and not against it. In agricultural terms, this means growing plants in the right soil, at the right time; nourishing the soil and relying on a system's biodiversity as a natural means to safeguard the whole system's health. Traditional wisdom is being maintained by many societies, while it is also being recreated in many "modern" farms. As shown by Reinders (p. 32), farmers in many of the intensive agricultural areas in the Netherlands have a very similar approach towards pests and diseases: this is not a separate problem which needs to be solved in isolation. Pests and diseases are dealt with by managing a farm as a whole. Managing a farm, however, and relying on its ecological processes, requires a thorough understanding of how these work. Therefore EPM is, above all, based on farmers' skills, abilities and knowledge.

Building knowledge

If EPM is based on farmers' understanding of their ecosystem and of the processes taking place in it, then training, education and knowledge building processes are essential. Many different participatory approaches for promoting sustainable agriculture have been developed, most of which work towards improving farmer decision making capacities and stimulating local innovations. Experiences showing the positive results of Farmer Field Schools, as a "model approach for farmer education", have been widely reported in the LEISA magazines.

Through Farmer Field Schools, farmers are trained to make an analysis of their agro ecosystem. In this way they become aware of the pest–predator balance and of the damaging effect of pesticides on such balance. They learn that it is better and more profitable to work with nature rather than against it. FFSs have become a very popular approach, taken up by NGOs and governments, on a small and a large scale. Their comparative advantage relies on a skilful incorporation of several principles: learner-centred, field-based, experiential learning; observation, analysis, assessment, and experimentation over a time period sufficient to understand the dynamics of key agro-ecological and socio-ecological relationships; peer-reviewed individual and joint decision-making based on learning outcomes; capacity building in leadership, social capital and empowerment.

The successes of the FFSs and other similar approaches show the truth of a common phrase: that knowledge is power. Understanding the ecological processes taking place in their farm not only helps farmers support and enhance such processes. It also helps to reduce the high degree of dependency many farmers have on chemical inputs and on the system –and vested interests– behind them.

Challenges

Ecological pest management is about bringing the balance back to disturbed ecosystems; it is also about learning to observe such balances. The enormous impact which pests and diseases have in today's agriculture forces us to pay special attention to these issues. Thinking of a cost-benefit analysis, for example, or on the need to easily visualise the impact of any pest management strategy on our health and on the environment, we need to continue developing tools to facilitate this learning process, building on the many successes seen.

However, as Schut and Sherwood show (p. 28), the widespread dissemination of Farmer Field Schools during the last ten years needs to be reviewed with a critical eye. In many cases they need to be modified so that they really reflect farmers' needs and are based on their knowledge and interests. In many others, it has to be recognised that the approach has "eroded" as a result of complex social matters and opposing interests. It is becoming clear that until and unless these are addressed, Farmer Field Schools will not lead farmers to a lasting independence from the pesticide trap. They may easily fall back into old practices or, even worse, they may resort to GM crops and find out later that their dependence on pesticides has only increased.

Our main challenge is therefore to keep the collective learning spirit that has been built by approaches like the FFS alive. In all situations, farmers need to decide on how to control the incidence of pests and diseases in their specific context, relying on the natural balances within their ecosystem. There are no standard recipes or solutions available. Yet, there is much wisdom to be tapped, both "old" and "new". Old practices are being "validated" by modern scientists. The challenge is to apply and adjust this wisdom in each specific situation.

■

Pest management: The art of mimicking nature

Mans Lanting

Photo: Author

Nurturing healthy plants in Yavatmal, Maharashtra, India.

This article presents a vision of how pest and disease problems in agriculture can be addressed. It is based on experiences in different semi-arid regions, mainly in India and West Africa. The principles which it looks at, though, are valid in any system and any climate zone. The title of the article refers to the conviction that sustainable farming needs to mimic nature in order to use ecological processes as the main method to manage pest and diseases, thus reducing the dependency on external inputs.

Nature and farming

Unlike in agriculture, in nature we seldom find massive destruction of vegetation by pests or diseases. We find high biodiversity of plants but also of animals, insects, bacteria and fungi. Nature is a system in which no component can easily dominate. Nature provides and promotes niches for diverse insects and animals competing with each other and living with each other. They die and decompose in the landscape where they lived. Nature recycles nutrients.

The introduction of permanent farming has, over the years, reduced biodiversity: moving from shifting cultivation to mixed cropping systems, then to mono-cropping systems with landraces of a relatively high genetic diversity, to improved varieties, to hybrids and to genetically modified crops. The latest developments mean that genetic diversity, even within the crop, has been very much reduced. Ecological logic suggests that, with decreasing biodiversity above the soil, biodiversity in the soil has also decreased. Attacks by pests and fungal diseases tend to increase over time, a process which is related to natural selection in an increasingly limited stock. Among the factors involved we have:

Imbalanced nutrition

Soil fertility decreases when the product is harvested. Farmers used to replenish fertility through the application of farmyard manure. But many farms have become too small to create sufficient manure. This has encouraged some farmers to resort to the easy solution of fertilizers. Unfortunately, an overdependence on chemical fertilizers has led to imbalanced plant nutrition: too much nitrogen in relation to all other macro- (P, K), meso- (e.g. Mg, S, Si) and micro-nutrients (e.g. Zn, B). Imbalanced plant nutrition leads to increased vulnerability to pests and diseases. There is ample evidence that very high levels of nitrogen attract sucking insects; that blast in rice is enhanced if the nitrogen/silicon ratio is wrong; that shortages of magnesium promote leaf-spot in groundnuts (on red soils); that zinc deficiencies lead to fungal diseases (in mango and finger millet).

Decreasing water-holding capacity of soils

The lack of organic matter in soils -caused by erosion, reduced application of farm yard manure and accelerating decomposition due to nitrogen application- leads to moisture stress, which also increases the susceptibility of plants to pests and diseases. For instance, thrips attack plants when they suffer moisture stress; groundnut shells crack due to water stress, which creates entry points for fungal diseases and subsequently aflatoxin problems.

Monocropping and loss of natural vegetation in the landscape

The reduction of biodiversity in agricultural systems has also increased the relative abundance of insects that can live in such simple ecosystems. In the same way, harmful animals like rats and wild boars can easily survive; there is almost no niche for their predators (snakes, owls, wild cats). This can becompared with a supermarket where, because the food is so easily available, there are plenty of mice but the cats are absent.

Broad-spectrum pesticides

The use of broad spectrum pesticides has had a severe impact on the abundance of predators. The pest-predator ratio has been severely and negatively impacted. This applies to insects as well as to birds.

Irrigation

The introduction of irrigation also promotes harmful insects as the normal period of drought, and thus absence of a host plant, has disappeared. Host plants are present throughout the year and thus the pest population can survive. Crop selection by farmers aggravates the presence and persistence of harmful insects in irrigated systems. Farmers look at the earning capacity of a crop and rely on pesticides to control the pest that goes with the crop. There are many examples of farming systems that promote pests (for instance cotton bollworm in Guntur, Andhra Pradesh, India) through each and every crop grown during the year.

Prevention is better than cure: Back to nature

The main strategy for pest and disease management in LEISA farming systems is to reduce stress to the crop and strengthen ecological processes that control pests and diseases. This means ensuring that the crop is not:

- exposed to excessive drought or moisture;
- subjected to nutrient shortages and imbalances;
- facing excessive competition from other plants (for space, light, water or nutrients);
- exposed to extremely high or extremely low temperatures;
- grown as a monocrop in a landscape almost devoid of trees, shrubs, wild fauna and flora.

How can this be done? Organic matter in the soil is an important factor in improving growth conditions. It will improve soil structure and allow rainwater to infiltrate into the soil. This will reduce run-off and thus increase water availability, reduce water stagnation and provide better growing conditions for plants. It will also improve the water holding capacity of the soil, improve aeration and oxygen availability in the soil and it will also lower or increase the pH of the soils. All these are beneficial for the crop.

Systems for holding water can be created: pits dug in the field, dead-furrows, tied-ridges, vegetative bunds, earthen bunds with overflow structures, terraces. All these actions will help to reduce drought stress. Drainage of excess water is equally important: farmers growing ginger on flat soils face more bacterial wilt problems than those growing ginger on raised beds with a well designed water drainage structure, such as those seen in Sikkim and Kerala in India. Black cotton soils are notorious for water stagnation; their drainage is imperative. Farm ponds in the drainage system are a good strategy to use the water when long spells of drought occur.

Finding enough compost is a challenge for many faming families. It is possible in some farming systems, for example, by growing a green manure crop before the main crop. A one metre wide border crop of densely sown Sunn hemp (*Crotalaria* sp.), *Cassia siamea* or *Glyricidia* around the field can produce four tons of compost per acre after 3 years. Where animals are part of the system, it is important to make best use of their manure, collecting it where necessary.

Enhancing biodiversity

Many elements make up a farming system with high biodiversity – a main crop, border crop, trees, intercrop, and animals. Biodiversity can be enhanced further by introducing:

- trap crops (often crops with yellow flowers, like Indian mustard, sunflower, marigold, soybeans and French beans);
- crops that promote predators (e.g. pulses for the ladybird beetle, okra for the lace wing, coriander, sorghum, maize for *Trichogramma*);
- visual/physical barriers through densely sown border crops (e.g. the diamond backed moth needs to see cabbage).

After such interventions a field would have about 10 crops growing. It is thus becoming a fairly rich eco-system. The applied compost will provide feed for microbes in the soil which will enhance biodiversity, especially when micro-organisms have been added to the compost. The trees will encourage birds that will feed on boll worm or *Spodoptera,* for instance, but of course also on grains (the main reason why farmers want to remove trees). So it is not only vegetative biodiversity that will increase, but overall biodiversity.

Another possibility is to create patches of nature on community owned lands within a landscape. The best way to do that is to fence the areas temporarily and prohibit entry for a period of about 5 years. The nature that regenerates is highly diverse and suitable to the environment. These patches of nature can then be refuges for larger predators. Of course they are seen by many scientists also as source of pests and diseases. Only experiments will show who is right.

Crop management

Time tested local varieties should be preferred, unless it is clear that they are genetically degraded or that climate has significantly changed (onset of rains, end of rains and distribution). It would be recommendable to try and improve the varieties by selecting healthy and high yielding plants as the seed for next season. However, we should not be romantic: many crops and varieties have been introduced into farming systems relatively recently (1960s and 1970s). Though it is tempting to work with hybrids to improve yields, it would often be better to grow varieties that have good characteristics. They can be multiplied by farmers themselves, provided a good system of seed selection is implemented.

Timely planting, and choosing the right crop and variety are crucial. Often farmers will have to change varieties if they are forced to plant late due to late rains. Long term weather expectations are important in the choice of varieties or even crops. For years, farmers have observed nature's response to climate. Often they have found natural indicators for predicting good and bad rainy seasons (for example, in northern Ghana it was related to the fruiting pattern of *Acacia nilotica*). Such indicators can be correct, but in some cases they also might be wrong, so each case needs to be studied in detail. Attention needs to be paid to long term weather predictions, and possible alternative crops need to be discussed with farmers.

Plant density is an often overlooked factor in farming sytems. Too high or too low density can be found in many farmers' fields. Both situations can promote pest and disease attacks. Thus, it is important to maintain the optimal plant population. The densities depend on soil type, so it is wise to experiment and not just follow what researchers say.

When all these measures are taken, pests are usually kept at bay. However, there might still be problems emerging. It is possible to monitor these, and partially control them, by using sticky traps (bright yellow, light blue), light traps, pheromone traps and field observations. It is important to notice the onset of a pest problem, in order to manage it with relatively simple measures before it gets out of control. In many cases it is preferable to use anti-feedants like neem seed kernel extract, repellents like cow-urine, chilli or garlic sprays. Botanical pesticides are usually broad spectrum killers and lead to similar problems as broad spectrum chemical pesticides.

In conclusion, the best strategies for pest management are based on ensuring optimal conditions for plant growth: a soil rich in organic matter, balanced nutrition, good plant population and a high diversity of plants attracting, repelling harmful insects and promoting predators of all kind. It is necessary to look wider than at only one field: the whole cropping pattern of a farm and an area will promote or control pests and diseases. The natural environment too can contribute to controlling or promoting pest incidence. Only if we fully understand the ecology of pests and diseases, can we live in harmony with them instead of fighting them.

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Enhancing the Push-Pull strategy

David Amudavi, Zeyaur Khan and John Pickett

Millions of rural people in Eastern Africa depend on maize and sorghum for food security and cash income. Despite this, production of these crops is seriously affected by constraints such as stemborers, the parasitic weed *Striga hermonthica*, low and declining soil fertility, lack of knowledge on how to manage these pests and weaknesses in the extension system. Stemborers lead to yield losses of 30 - 40 percent, while Striga infestation causes a loss of 30 - 50 percent to Africa's agricultural economy on 40 percent of its arable land. Although chemical control is usually recommended, it is uneconomical and impractical for many small-scale farmers, and has negative impacts on the environment and human health. On the other hand, the commonly used cultural method of uprooting Striga is labour-intensive and less effective. Adoption of effective control methods is limited due to lack of labour, little knowledge about the pest problems, and lack of other resources needed to make the necessary investments.

Affordable alternative strategies are needed to combat the growing threats to the smallholders' livelihoods. One such method is the "Push-Pull" strategy. This combines knowledge of the chemical ecology and agro-biodiversity of the stemborer, with Striga management. This strategy was developed by scientists at the International Centre of Insect Physiology and Ecology (ICIPE) in Kenya and Rothamsted Research in the United Kingdom, in collaboration with other research organisations in Eastern Africa. A first article about Push-Pull in *LEISA Magazine* (Vol.17 No.4, December 2001) presents it as a viable "organic" alternative to genetically modified maize (Bt maize). This article explains how the Push-Pull strategy has been adopted by farmers in Kenya since then.

How does the Push-Pull strategy work?

Push-Pull uses a combination of legume repellent plants to deter the pest from the main crop ("push") and trap crops to attract the repelled pest ("pull"). Molasses grass (*Melinis minutiflora)* and Desmodium (*Desmodium uncinatum*) are the common repellents, whereas Napier grass (*Pennisetum purpureum)* and Sudan grass (*Sorghum vulgare* var. *sudanense)* are the common trap plants. Research has shown that the repellent plants produce chemical compounds, some of which repel the stemborer pests. On the other hand, during dusk Napier grass produces other chemical substances that evaporate easily, some of which are good attractants for stemborers to lay eggs. Fortunately, Napier grass produces a gummy substance which traps the resulting stemborer larvae, and only few survive to adulthood, thus reducing their population.

Push-Pull also suppresses and eliminates the Striga weed through several mechanisms, including nitrogen fixation, soil shading and allelopathy. Allelopathy is where one plant harms another with chemical substances: Desmodium roots produce such chemical compounds. Some of these compounds stimulate Striga seeds to germinate but others inhibit lateral growth and the attachment of the Striga roots on to maize roots. The Striga dies, and eventually the number of Striga seeds in the soil decreases. As Desmodium is a perennial crop, it controls Striga even when the host crop is out of season, making it a better repellent than other legumes.

Opportunities for diversifying livelihoods

The Push-Pull strategy is a good case of how basic research can contribute to the enhancement of agricultural productivity and improvement in the sustainable use of natural resources. The strategy provides several benefits, directly or indirectly contributing to the livelihoods of rural families. Such opportunities include:

Improving food security
Push-Pull has increased maize yields of farmers in Kenya by an average of 20 - 30 percent in areas with only stemborers (Trans Nzoia district), and by more than 100 percent in areas with both stemborers and Striga (e.g. Vihiga, Siaya, Suba and Migori districts). This has been a key incentive for its increased adoption.

Reduced soil erosion and increased soil fertility
By providing a good ground cover, the strategy improves soil conservation. Through nitrogen fixation, the strategy reduces the required amount of nitrogen fertilizers, which are unaffordable by most smallholder farmers. A long-term study at ICIPE's on-station fields in Mbita, western Kenya, has shown a significant increase in total nitrogen on field plots under maize-Desmodium intercropping for three years, especially when compared to maize fields intercropped with other legumes.

Enhanced biodiversity
The Push-Pull strategy promotes and conserves biodiversity by maintaining species diversity. This, in turn, improves natural and agricultural ecosystems by contributing to ecosystem services such as nutrient cycling and decomposition. This helps in developing sustainable crop protection systems which rely less on pesticides. A study conducted in Lambwe Valley (Suba district, Kenya) shows that the strategy is associated with an overall enhancement of beneficial predators, which is important in agricultural systems.

Livestock production and human health
Unstable availability and seasonality of livestock feed have been major constraints to improving dairy livestock in Eastern Africa. Push-Pull provides quality fodder for livestock. On small farms where land pressure is high, this is likely to improve the health of farming families, especially children. Improved dairy cows and goats are emerging as important income alternatives for smallholder farmers.

Protecting fragile environments
Higher crop yields and improved livestock production, resulting from habitat management strategies, have the potential to support rural households under existing circumstances. This can slow the migration of rural populations to areas designated for protection. Moreover, farmers using such strategies have less reason to use pesticides that could affect flora and fauna in the agro-ecosystem.

Income generation and gender empowerment
Push-Pull has shown promising impacts of not only enhancing farm incomes but also empowering rural women. It provides alternative income sources, as surplus grain, fodder and Desmodium seed can be sold. It also has potential for improving the quality of rural life as more partners interact with farmers to disseminate it to other farmers.

Push-Pull dissemination to smallholder farmers

The Push-Pull strategy has been adopted by more than 10 000 households in 19 districts in Kenya, five districts in Uganda,

Photo: Jimmy Pittchar / ICIPE

Consolata enjoys talking about the success of her Push-Pull fields, and sharing her knowledge with others as an FFS facilitator.

and two districts in Tanzania. It is being promoted by the public extension system, non-governmental organisations, the private sector, and by regional partners in these three countries. Previously, the strategy has been disseminated through mass media (a radio programme called *Tembea na Majira)*, printed material (newspapers, brochures, information bulletins and posters), farmer field days comparing Push-Pull and conventional cropping systems, agricultural shows, farmer-to-farmer extension (farmer teachers), on-station demonstrations, and public meetings (*barazas)*. These methods have produced variable achievements.

The Farmer Field School (FFS) approach is now being used to disseminate this strategy as it is knowledge-intensive, and the FFS approach is likely to increase economies of scale by reaching out to many thousands or millions of farmers. The FFS approach uses a curriculum developed by stakeholders involving farmers, government extension staff, researchers, FFS and curriculum specialists, ICIPE scientists, and staff from NGOs and community-based organisations. The curriculum includes weekly sessions during two cropping seasons, largely based on the life cycle of maize, namely: (a) pre-season weekly sessions of five weeks covering activities that prepare the ground for FFS formation and implementation, (b) a first season of 21 weeks corresponding with the first maize cropping season activities, (c) first off-season sessions of two weeks involving relevant economic activities, and (d) a second season of 23 weeks corresponding with the second maize cropping season. The programme follows two seasons because during the first season, the companion crops (Desmodium and Napier grass) are not fully established for farmers to learn how to manage them. Additionally, given the emphasis on learning by observation and discovery, learning how to conserve and utilise Push-Pull products is made easier during the second season. During this season farmers also learn how to establish Push-Pull plots using Desmodium vines and Desmodium seed multiplication plots. The curriculum also involves collecting relevant information for assessing the effectiveness of the Push-Pull strategy.

Following the successful launch of the Push-Pull curriculum in Bungoma district in western Kenya, in March 2007, ICIPE organised a first training workshop for FFS facilitators the following month. The objective was to train facilitators on the strategy, learn how to implement it in a field school, and develop facilitation and group management skills. The workshop was attended by experienced FFS facilitators from Bungoma and Busia districts and potential facilitators from Suba and Homa Bay districts, all in western Kenya. After the training, the facilitators from Bungoma and Busia started implementing the curriculum in the existing FFSs. Now there are 22 and 12 FFSs in Bungoma and Busia respectively. One such school in Bungoma, the Ngwelo FFS, started in 2005 initially to learn about conservation agriculture in growing groundnut and water melon. Its members had some prior knowledge about Push-Pull through the Push-Pull radio programme. Some of the FFS members were among a group of farmers who took a study tour to the ICIPE-Mbita station to see the Push-Pull demonstration site. They were encouraged by the superior performance of Push-Pull compared to other legume intercrops. The school then approached the Bungoma district Umbrella FFS Network to provide an experienced facilitator whom they pay weekly stipends. Ngwelo FFS has provided useful lessons for establishing FFSs in other areas in western Kenya.

ICIPE organised a second workshop in June 2007 at the ICIPE-Mbita station to train FFS facilitators from the Suba and Homa Bay districts. First, interested farmer groups were identified through focus group discussions with experienced Push-Pull farmer teachers and non-practising Push-Pull farmers. These discussions were used to find out about the groups' profiles, members' access to information, and experience with Striga and stemborer control. They also provided entry points for raising awareness among farmers about the strategy and role of FFS in providing opportunities to learn new or improved strategies. Each group then selected one farmer to attend the


Photo: Philemon Orondo / ICIPE

An FFS Farmer facilitator demonstrates how to plant Napier grass around a maize field; Lambwe Valley, Suba.

facilitators training workshop. As in the first training, this was also supported by experienced FFS facilitators from established FFSs in Bungoma district. The trainees visited ICIPE's on-station Push-Pull fields at Mbita and several Push-Pull farmers in Suba. Later, the Suba and Homa Bay facilitators visited Farmer Field Schools in Bungoma district, where they observed how a typical FFS is organised. They engaged in observational learning, asked questions and sought clarifications. They also visited Desmodium seed bulking plots. Using this strategy of training, ICIPE has trained more FFS facilitators in about ten districts in Western Kenya. It has also organised training for farmers from Uganda, who will eventually be trained as FFS farmer facilitators.

Success story

Consolata James is a mother of four children, living in Ebuchiebe, a village in the Luanda division in Vihiga district (western Kenya) with 3.5 acres of land. She was among the first 12 farmers from Vihiga who visited the ICIPE-Mbita station and the farmers in Suba in 2001 to learn about Push-Pull. Following this field experience and with technical support provided by the ICIPE field staff, Consolata and the other farmers planted Push-Pull fields. Currently, Consolata is the facilitator of an FFS in Ebukhaya village in Vihiga district.

Consolata used to harvest about 45 kgs of maize per season from a 0.25 acre plot. During the 2002 long rainy season she started using the Push-Pull strategy and harvested about 270 kgs. This motivated her to increase her Push-Pull acreage to half an acre in 2006. Since then she has been selling some of her Napier grass to neighbours. She has also acquired a dairy goat, which she feeds on her own fodder. She has increased her livestock herd and her milk production has increased dramatically.

Consolata has disseminated the Push-Pull strategy to several other farmers in her neighbourhood. She has been an example to others, with over 30 visitors to her farm from outside the district. Consolata is gradually expanding her Push-Pull fields, leaving a small portion of her farm for planting maize and beans. Asked to sum up what she enjoyed most about the strategy, she said: "I don't have to buy a lot of maize from the market to feed my family. Push-Pull has also enabled me to have more livestock".

Future outlook

Push-Pull is not a universal remedy for solving smallholder farmers' problems, but it can provide opportunities for diversifying livelihoods. The major constraint to its dissemination to thousands or millions of farmers has been the non-availability of Desmodium seed. Several opportunities have emerged, including involvement of a private seed company, community-based seed production and vegetative multiplication. The relative merits of these in stimulating the diffusion of the strategy are being investigated. In addition, the effectiveness of different dissemination pathways, such as mass media, print media, farmer-to-farmer advisory and Farmer Field Schools are being evaluated to provide lessons for improving the dissemination of Push-Pull.

Work is underway to develop tools for ensuring the performance of new Push-Pull components, as well as to improve our understanding of soil nutrient dynamics. Research is also ongoing into the emerging problems of a previously unrecognised pest (a pollen beetle attacking Desmodium) and a disease of the companion crops (phytoplasma disease in Napier grass). Questions relating to the potential integration of new production and protection strategies (e.g. Bt maize) or their complementarities have been raised. This has stimulated the need to evaluate crop productivity and protection strategies in continued collaboration with other centres. The Push-Pull strategy thus lays the foundation for wider scientific work and serves as a model for the management of other pests in Africa and beyond.

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Ecological pest management for emerging pest problems

Bikramjit Sinha, Randhir Singha and Dhrupad Choudhury

Since the beginning of agriculture, around 12 000 years ago, humans have been struggling to reduce the adverse effects of pests on crop production and storage. The development of synthetic pesticides revolutionised pest management in agriculture. However, ecological and human health risks, together with the economic costs of heavy reliance on chemical pesticides have become more apparent. In this context, it is relevant to recall Julian Huxley's lines in his preface to Rachel Carson's revolutionary book, "Silent Spring": "Pest control is of course necessary and desirable, but it is an ecological matter, and cannot be handed over entirely to the chemists".

Meghalaya, a small state in the North Eastern region of India, is inhabited by different indigenous communities, mainly of Mongoloid origin. Of the approximately 2.3 million population, about 85 percent live in rural areas and depend on agriculture for their livelihood. Due to physiographic features, shifting cultivation and *Bun* cultivation (raised beds on slopes) have been the predominant forms of agriculture. Traditional fallow periods of 20 - 30 years have now reduced to 3 - 5 years, mainly due to pressure from increasing populations. In response to this, the state government introduced the settled form of agriculture called wet rice cultivation during the 1980s. Farmers were encouraged to use high yielding varieties and subsidised agro-chemicals. This led to a dramatic increase in the total cropped area in the state: an increase of about 42 percent during the last twenty-five years.

The emerging pest problems

Many studies indicate that fewer pest problems are experienced in shifting cultivation due to its inherent management practices, such as mixed cropping, fallowing and rotation. In contrast, continuous monocropping in settled cultivation is reported to contribute to the build-up of pests and diseases. The introduction of wet rice cultivation in Meghalaya has also brought new pests to the area. The Indian Council of Agricultural Research for North Eastern Hill Region, while studying the pests in upland agriculture, found that paddy grown in shifting cultivation fields are almost free from insect pests, while those grown in semi-terraced lands had moderate incidences of the gundhi bug (*Leptocorisa oratorius*). On the contrary, crops grown in terraces were found to be attacked by a number of pests in addition to the gundhi bug, like stemborers, the rice hispa, rice caseworms, leaf folders and hoppers. Farmers say that the terrace cultivations initially provided good harvests. However, infestation of paddy by different types of pests previously unseen, soon became a major cause of concern.

The extension and support delivery systems in the state are comparatively weak. This is probably due to poor infrastructure and the lack of extension personnel willing to work in remote, harsh areas. Even where such services are available, the upland people often cannot afford to use these services. Traditionally, farming was done for subsistence rather than for commercial benefit, and the farming system was self-sustainable with zero external inputs. Though the newly introduced settled cultivation is also mostly carried out for subsistence only, it depends on costly and inaccessible external inputs, making it much less sustainable. This is a matter of serious concern among those farmers who have adopted wet rice cultivation on a larger scale, as their long-term survival is at stake.

Participatory research was carried out to document and assess the traditional pest management practices followed by the three dominant tribes of the state: Khasi, Jaintia and Garo, inhabiting the West Khasi Hills, Jaintia Hills and West Garo Hills respectively, and to assist them in sustainable food grain production in an ecofriendly manner. The study was started in 2002 through the IFAD-funded North Eastern Region Community Resource Management Project for Upland Areas, and is still ongoing through other small grant projects.

Farmer's response

The innovative nature of indigenous communities can be seen among the farmers of Meghalaya, and is evident from the array of pest management methods they have developed to control different kinds of pests which came along with the newly introduced settled wet terrace paddy farming. Most of these methods were developed and are being developed based on locally available resources. The methods are environmentally friendly because chemical pesticides are not used, and most importantly, because they have strong foundations in well-established biological and ecological principles.

For instance, the use of fruit bearing trees to attract predatory birds (Box 1) by the Garos of the West Garo Hills district is a clear demonstration of sustainable biological control of pests. Unlike the conventional biological control methods in which the introduced predator or parasite itself may become a problem, the sustainability of the traditional method appears to be high, as it uses local plants to attract local predators. Such methods further reflect the community's understanding of food web linkages and population interactions. They harness the help of predators to remove the pests – a basic ecological principle of population control that operates in a natural ecosystem. Another important ecological principle implicit in this method is the conservation of flora and birds, even though it is not perceived by the farmers.

Box 1. Planting of fruiting trees in and around crop fields to attract predatory birds

Farmers of the West Garo Hills plant fruit bearing plants like *Bridelia retusa*, *Dendrophthoe falcata*, *Morus macroura* and *Sapium baccatum* in terraces, sometimes in home gardens and *jhum* fields. These plants attract predatory birds by providing shelter and food. The birds eventually keep pest populations down by feeding on the different kinds of insect pests, mainly larvae, caterpillars and nymphs. Though no-one can identify who started this method, the farmers unanimously agree that its development is linked with the traditional activity of hunting. A long time ago, while hunting in the forest, farmers noticed that some birds prefer particular plants, and that these birds were also seen to feed on caterpillars as well as small insects. Those farmers tried planting these plants near the crop fields, to see whether the birds would feed on the insect pests. These methods are now commonly practised. The farmers' philosophy about this method is simple: "We arrange food and shelter for the birds, in return they take care of our pests"

Rats are also controlled by employing the same principle. Branches, preferably of bamboo, are put in terraces. They act as a resting place for owls at night, which will keep the rat population in check.

The Khasis of West Khasi Hills practice another interesting method, and use cow's blood to repel birds from paddy fields. A small bird species, locally known as *phreit*, comes in flocks and damages the paddy, breaking the tillers. Usually it destroys the crop during the maturation period. To stop this, farmers put fresh cow's blood in a bamboo pipe. The pipe is tied with a stick and is placed in the paddy fields. According to the farmers, after 2 or 3 days the blood starts to emit a smelly gaseous substance, which acts as repellent to the birds. This practice also suggests an understanding and exploitation of the principle of animal behaviour, as it seems to mimic situations where alarm behaviour of the birds is used to prevent crop damage.

Perhaps the most widely-used of all the traditional pest management practices is the use of decomposing crabs to control rice bugs (as the filling of paddy grain starts, locally available crabs are smashed and put on pointed bamboo sticks in terraced paddy fields). This is practised throughout the entire state by all communities. An in-depth study of the practice suggests that it is an exploitation of the principle of food preference. This practice is environmentally friendly, as some farmers replace the crab baits as soon as they dry up, which otherwise may lead to elimination of the bug species from the natural ecosystem – not desirable from a conservation point of view. It also conserves water, as collecting the crabs lessens the loss of water through crab holes. Though other small animals like snails or frogs can also be used to attract the bugs, crabs are believed to be more effective. On-farm trials of the method

Photo: Sangita Roy

The crab bait traps can be used in combination with other traditional methods of managing pests.

Traditional ecological management of

Shantanu Kumar, Uma Sah and P.H. Singh

Potato is an important crop in the state of Meghalaya, India, occupying a major place in the agrarian pattern as well as in the dietary habits of the population. However, the average productivity here is only 9.2 t/ha, far below the national average of 18 t/ha. Factors like rainfed conditions, non-availability of quality seed, and high disease incidence, contribute to the present poor yield level. Potato is grown in two consecutive seasons: summer is the main potato-growing season that extends from February to June-July, while autumn extends from July-August to November-December.

Common potato cultivars

Khasi tribal farmers grow improved potato varieties as well as local varieties. They usually grow a mix of these varieties according to their characteristics and suitability. For example, *Kufri Jyoti* is a high yielding potato cultivar which covers over 50 percent of the total potato growing area in the state. Farmers prefer this variety for its taste and better cooking and keeping qualities. Initially it was highly resistant against late blight, however it has recently become very susceptible, causing low yields. *Kufri Megha* is another popular variety, liked for its taste and cooking quality. However, it is slow bulking and long duration, so it cannot be included in all the crop rotations farmers use. Farmers realise that its high resistance against late blight helps assure production, and therefore income. Hence, even if this variety is out of the breeder's seed production chain, farmers maintain its seed independently. *Kufri Giriraj* is a recently introduced variety. It is high yielding as well as resistant to late blight, and is gaining popularity. However, farmers are still doubtful about it, owing to its poor keeping quality and short dormancy.

Late blight is the major potato disease in Meghalaya. It appears in epidemic form every year around the second week of May, and causes total crop damage within 15 - 20 days of appearance. In cases of severe incidence, even the stem and tuber are affected. The affected leaves turn from green to brown or black, get dry and develop white cottony growth on the underside. The disease continues till October, affecting the summer as well as the autumn potato crop. However, the damage is higher in the autumn crop as it affects the crop in the initial growth stage.

Farmers' wisdom of traditional late blight management

Through experimentation, farmers have evolved a unique way to cope with the late blight menace. They have utilised the limitations in potato cultivation to their benefit, by adopting different crop rotations in low-lying areas and on hill slopes. In low-lying areas, farmers practise a potato-paddy rotation, whereas on hill slopes a potato-potato/vegetable rotation is followed.

For the management of the potato-paddy rotation in low-lying areas, farmers follow two practices. Firstly, they plant potatoes revealed that by using a crab of 2.5 x 3 cm size as bait, 80 - 85 bugs can be trapped per 5 m^2 in five days. Impressed by the effectiveness of the method, the state government has recommended its inclusion in the formal plant protection package. They are promoting a modified trap through agricultural bulletins, and at farmer trainings. The modified technique has been incorporated in the IPM recommendations for rice bugs, and is being successfully implemented in the entire state. Though there are no figures about how many farmers have adopted the customised trap, many farmers simply use the crabs in the traditional way. In all, the whole farming community can benefit from the renewed interest in age-old traditional methods.

The way ahead

The above descriptions are just a few of the hundreds of traditional ecofriendly pest management practices developed by the traditional farmers of Meghalaya in response to the pest problems emerging from the newly introduced wet terrace cultivations. The uniqueness of these practices is their suitability to the local conditions; they are inexpensive and easy to implement. The farmers state that when they use these methods in combination, they can be very effective. As different practices are used for the same purpose (pest) at the same time, one practice complements another, resulting in less pest damage to the crops. To be recommended for wide-scale use, however, these traditional practices need further evidence and modification. Nevertheless, integration of the authenticated traditional methods and their wider applicability may ensure a more sustainable and higher return from the fields – a step towards the reduction of rural poverty and hunger. Lastly, if the pest problems are taken care of, wet rice cultivation may prove to be a good alternative form of cultivation for the traditional farmers of Meghalaya in particular, and shifting cultivation areas in general.

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late blight in potato

comparatively early (by the first or second week of February), and harvest it in the first fortnight of June. After harvest, farmers prepare land and sow paddy by the end of June. In this way, the potato crop has three months to mature before it dies with late blight incidence. Secondly, in these low lying areas, the *Kufri Jyoti* variety is used. Although it dies before full maturity, *Kufri Jyoti* yields well, and damage to the crop is minimised by early planting and harvesting. This also allows for timely planting of paddy. After harvest, farmers sell the potato crop immediately, and fetch a premium price for the early harvest. This compensates for the yield loss due to early harvesting and late blight damage. Supplementing the practice of early planting of potato, farmers do not spray any fungicide for late blight management. Thus, potato is harvested in the first week of June and ecological sustainability is ensured.

Khasi tribal farmers select seed potato from the crop grown on the hill slopes, saying that disease incidence is lower there. These potato varieties also suit the crop rotations used on the slopes, and meet the requirements for seed potato. The majority of the farmers do not spray fungicide on hill slopes as they prefer to harvest early so as to prepare land for the second crop, such as cabbage or cauliflower. Farmers perceived that spraying fungicides on the crop could lead to increased duration of the crop, which is unfavourable for this cropping sequence. In addition, spraying the crop with fungicides may not greatly increase its yield, as late blight appears in a devastating form by the second fortnight of May and the entire foliage of the crop is destroyed by the first week of June. By this time sufficient tuberisation has already occurred in the crop. Thus, spraying summer crops with fungicide is felt not to be cost effective.

Implications

Farmers' traditional methods for managing the potato late blight in the Meghalaya hills are successful examples of ecological disease management and an established outcome of traditional experimentations. Such farmers' wisdom ought to be given attention in formal research systems. Moreover, by avoiding chemical fungicides, but rather working with the conditions they face, they are encouraging local ecological sustainability, which is important in such rainfed and hilly areas. This provides an opportunity for late blight management scientists to examine and validate such practices.

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The theory of trophobiosis in pest and disease control

Maria José Guazzelli, Laércio Meirelles, Ricardo Barreto, André Gonçalves, Cristiano Motter and Luís Carlos Rupp

In agriculture, as in nature, a healthy system is most easily achieved in environments which have the greatest variety of species. A diversified agricultural system is more able to maintain its equilibrium through the multiple relationships which exist between the biotic and abiotic components. It takes some time for an agro-ecosystem to become capable of regulating pest and disease problems through the biological control performed by parasites and predators. This ideal equilibrium is still not the reality in many agro-ecological production systems. Small scale monocropping can still be found even in ecological or organic agriculture, due to access to markets or market demand. Reducing these monocultures will depend, among other things, on changes in markets and customers' habits. In addition, situations of environmental stress, such as droughts, excessive rainfall, heat or cold, can encourage incidence of pests and diseases, putting ecological production at risk.

It has long been known that plants which are fertilized with organic material present few pest and disease problems. It is also well known that with the modernisation of agriculture, the number of species which are now regarded as pests and diseases has increased. Studies done by the French researcher Francis Chaboussou provide the basis for the theory of trophobiosis, which allows for a significant link to be established between these two observable facts verified in practice by farmers.

The theory of trophobiosis

The theory states that the susceptibility of a crop plant to pests and diseases depends on its nutritional state. Pests and diseases will not attack a healthy plant. The health of a plant is directly associated with its internal balance, which is constantly changing. According to Chaboussou, it is not just any plant which is attacked by pests and diseases, but only those which could serve as food for the insect or pathogen. In other words, the cultivated plant will only be attacked when the food these pests need is available in the sap. If a plant has sufficient quantity of the substances which are food for the pests and diseases, it is because it has not been cultivated in an optimal way. So, for a plant to be resistant, it is important to manage its growth in the correct manner. All factors which affect a plant's internal balance and functioning can lessen or increase its susceptibility to pest and disease attacks. These could be factors related to the plant (such as adaptation to the local climate, plant age, grafting) or the environment (climate, light, temperature, humidity, wind), or be associated with management practices (such as soil fertility, time of planting, spacing, tilling, pruning, type of fertilizers used).

Table 1. Indicator plants

Indicator	Scientific name	What it indicates
Sorrel	*Oxalis oxyptera*	Clay soil, low pH, lack of calcium and/or molybdenum.
Purslane	*Portulaca oleracea*	Well structured soil, with organic matter.
Barnyard grass	*Echinochloa crusgallii*	Soil lacking aeration, with nutrients that can be toxic.
Sedge	*Carex* spp.	Poor soil, with very low levels of calcium.
Amaranth	*Amaranthus* spp.	Available nitrogen (organic material).
Bracken	*Pteridium aquilinum*	Excess toxic aluminium.

Source: Adapted from Primavesi, 1989.

Photo: Centro Ecológico

Farmers meet often to exchange information and experiences with bio-fertilizers.

In the 1980s, the technical team of Centro Ecológico/Ipê, an NGO in Rio Grande do Sul, Brazil, along with farmers and other technicians, were looking for ways to overcome some of the technical difficulties in ecological production. They were specifically testing out Chaboussou's ideas that the nutritional state of a plant is a result of interaction between its genetics, the local environment and management practices. In this way, cultivation practices were aimed at understanding the causes of the problem, rather than only treating the consequences, such as pests, diseases and low productivity.

Application of the theory in practice

This region of Brazil was mainly occupied by Italian immigrants, who developed a form of subsistence agriculture and then introduced the grape for commercial purposes. With the modernisation of agriculture there was a huge increase in vegetables and fruits, grown with intensive use of inorganic fertilizer and pesticides. This brought an increased incidence of pests and diseases, as well as environmental and health problems.

Eroded soils, low fertility, and the use of modern varieties of vegetables (mostly tomatoes and onions) and fruits (apple, peach and grape), which were less adapted to the local climate and suffering intense attacks of insects and diseases, were challenges to be overcome by ecological farmers. The changes began by removing the main cause of disequilibrium of the soil and plant – inorganic and soluble fertilizers. Instead, manure and green manures were introduced, even in the orchards which were planted under conventional systems. Next, farmers looked for ways of complementing plant nutrition. With these changes, the level of attack of most pests and diseases was tolerable.

One way of finding out more about the existing ecological situation is to look at some local biological indicators – such as weeds and the development of cultivated plants. Weeds provide good information about soils. For example, a soil dominated by *Digitaria sanguinalis* (also known as crabgrass) tells us that the soil structure is poor (Table 1). So, a cultivated plant grown here would probably use a lot of energy to establish itself, and may show nutrient deficiencies. In the same way, pests and diseases indicate the origin of the difficulties that the plants were having, such as lack of nutrients (see Table 2). These nutrients could be present in the soil, but are not being taken up by the plant. For example, blossom end rot in tomatoes happens due to lack of calcium in periods when the soil is very dry, and not necessarily due to lack of the mineral.

Table 2. Insects and diseases as indicators

Crop	Indicator	Indicates deficiency of ...
Tomato	Blossom end rot	Calcium
Beans	Tomato Spotted Wilt Tospovirus Whitefly (*Bemisa tabaci*) Bean Golden Mosaic Virus	Calcium
Cauliflower	Grey mould (*Botrytis* sp.)	Boron
Maize	Army worm (*Spodoptera* sp.)	Boron
Maize	Cornstalk borer (*Elasmopalpus lignosellus*)	Zinc

Source: Adapted from Primavesi, 1989.

In time we realised that even if we did not know the technical details of what was happening, we still could look for ways of improving plant metabolism, and therefore its health. This can be done by selecting the best plants each year and collecting their seeds, in order to have the plants best adapted to the area; by changing the soil management practices, using more green manure; or by letting weeds grow and using them as green manure.

Farmers also intervened directly in the plant's nutrition in order to improve its resistance – this is known as physiological control. They were interested in demonstrating that a healthy, well-fed plant will seldom be attacked by pests and disease, which will die of hunger on a healthy plant. Insects, nematodes, viruses and bacteria are the consequences of problems the plant is having, not the cause.

There are many cheap and simple products which can be used in farming systems to improve plant nutrition. Examples include ash, powdered rock or bio-fertilizers. Generally, such inputs are abundant, locally available and easily incorporated into farmers' management practices. A good example is a very common product: "enriched liquid bio-fertilizer". This is a cheap technology, which the farmers really do use, and which today can be found in nearly all ecological agriculture systems in Latin America. As an example, thrips disappear from onions when they are sprayed with it. Élio Chilanti, from Antonio Prado, in Rio Grande do Sul told us: "When we started more foliar nutritional treatments, the vines did not die so often, became more vigorous and the grapes were bigger. The nutritional treatments thickened the leaves and reduced the mildew."

Enriched liquid bio-fertilizers

Enriched liquid bio-fertilizers can be made with any fresh organic material. Usually, they are made with animal manure, but can also be made from just plant material. To enrich the mixture, minerals can be added, such as ashes or powdered rock. The minerals help the fermentation process and improve the quality of the final product. Adding milk, whey or molasses also helps the fermentation. When fermented they are used on the soil as well as in foliar sprays. In this case, they are very efficient at controlling various plant problems, because they help the plants' physiological functions to become more harmonious and balanced. It is also possible to make bio-fertilizer with materials the farmer has at home, which means he or she can improve the health of their plants independently. Home-made formulas of bio-fertilizers are easily owned, used and reproduced by farmers.

Enriched bio-fertilizers feed the plant, but it has also been discovered that bio-fertilizers protect the plant, acting as a defence mechanism. This defence could be due to different factors, such as a plant which is better fed has better resistance, as explained by the trophobiosis theory. If a plant has everything it needs at its disposition, in the right quantities and at the right time, it has all the conditions to defend itself from insect attack, mites, nematodes, fungi or bacteria. Also, because bio-fertilizers are a living product, the micro-organisms present in them can also help in the fight against harmful micro-organisms which are attacking the plant.

Conclusions

For the farmers Centro Ecológico works with, understanding and applying the theory of trophobiosis has been an invaluable experience. It has been a tool which has allowed an innovative and facilitative approach to try and understand and manage, with success, some of the technical problems which ecological farmers face. This is especially the case when seeking to do more than just substitute agrochemicals, but rather looking at the system as a whole and improving plant health and resistance.

As well as being based on solid and pioneering scientific knowledge, most of the accumulated knowledge has come about through participatory experimentation, and is intended to stimulate new initiatives by the farmers. If we can understand that for every difficult situation there will always be a reaction in nature, we can look for ways to improve imbalances in our farming systems. According to this theory, the correct way to protect plants is to prevent the attack of pests and diseases, by providing a healthy and balanced environment and food supply. This can be reinforced further if we stimulate physiological control, for example with the use of enriched liquid bio-fertilisers.

Our practical experiences, based on the theory of trophobiosis, have shown us that we can manage an isolated productive unit ecologically, or even just a part of it. Above all, an understanding of trophobiosis has been very useful during the process of transition to agro-ecological production systems, especially in times of environmental stress.

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Many farmers turn up at easily accessible plant clinics. Here, Jorge Luis Perez Salgado exchanges ideas as to what the problem might be.

Plant clinics for healthy crops

Jeffery Bentley, Eric Boa, Solveig Danielsen and A.K.M. Zakaria

Although "plant clinics" have been known in the U.S. and other countries for some years, a whole network is now emerging in countries like Bolivia, Nicaragua and Bangladesh, responding to the efforts of both governmental agencies and NGOs. Most of these are supported by the Global Plant Clinic (GPC), an international service led by CABI in the U.K. These "clinics" are simple places, often little more than a table and some chairs, in a farmer-friendly place in a small town. They usually operate just a few hours a week, allowing busy staff to pursue their other responsibilities as well. The "plant doctors" are local extension workers or farmers; its clients are all those interested in discovering what is wrong with their crops, and what can be done about them. Drawing on examples from these three countries, this article presents the "plant clinic" strategy and the possibilities it brings.

Tomatoes in Nicaragua

In September, 2005, Róger Céspedes had a problem: his tomatoes were dying, and he didn't know why. He planned to sell the harvest of his small field to support his family, but this looked more and more difficult. Twenty days earlier, he had transplanted the tomato, but only two weeks later the leaves had started to curl in a way he had never seen before. As the tomato leaves curled and the tips turned yellow, Róger concluded that this was a new disease. He sprayed various insecticides and fungicides, several times, with no success.

In desperation he went to the *Puesto para Plantas*, the plant clinic in El Jícaro, northern Nicaragua. Agronomist Dimas Sarantes was sitting behind the table, in the shady porch of the Cooperativa Santiago, a community co-op which does banking, agricultural extension and which even owns a store. Dimas listened carefully as Róger described the disease. The symptoms were too general to diagnose, just wilting, so Dimas asked Róger to bring in a sample, which he did. This was then sent to the government plant pathology lab, where they confirmed that the disease was bacterial wilt. Dimas was not able to save Róger's crop, but he was able to give him valuable advice about crop rotation. He was also able to convince him that this particular crop was lost, and to stop wasting insecticides and fungicides on it. Later, Dimas discussed bacterial wilt and crop rotation over the radio, on his weekly agricultural talk show on local Radio Líder, FM 96.7 in El Jícaro, which is heard over four municipalities. From this single diagnosis, a few thousand smallholder farmers were able to benefit from the practical advice given over the radio.

The wilting tomatoes in El Jícaro showed that plant doctors do not know everything, and that they need to rely on others to receive samples and make further diagnoses. But it also shows that they do not simply tell the farmers what to do, but rather receive them, listen carefully and then give an opinion (most frequently a second opinion, as the farmer has already thought about his problem and probably already asked somebody else). The regular contact which is established between plant doctors and their clients helps them work together to solve a problem. More important, perhaps, is that it is the farmer who goes and asks, rather than passively receiving an extension agent. This empowers the farmer. Farmers rarely, if ever, bring in pests or diseases which they can readily identify. The plant clinic, therefore, complements other efforts.

Beans in Bangladesh

Four years ago, Abdur Rahim started farming in his father's land in Demajani, a village in the Bogra district, in central Bangladesh. In the summer of 2006 he sowed beans, in a similar way as he'd done before. Initially, growth was good, but just before flowering Rahim observed that about one quarter of all twigs were rotting. He went to a pesticide dealer and heard that he could use Volkan, very low graded fungicide. After six sprays the problem seemed to be over. A few weeks later, Rahim was happy to find purple flowers and bunches of young beans. But the same disease attacked again, and this time it was more aggressive. Rahim returned to the dealer, who prescribed the same fungicide. Rahim wanted a second opinion. He was annoyed about the frequency and cost of spraying – and it hadn't worked.

Rural Plant Clinic 1, organised by the government's Rural Development Agency, is close to Rahim's village, but he had never gone to it nor shown any interest in it. He admits now that he felt "slightly allergic", as this clinic is run by female plant doctors. The problems he was facing made him think differently: "at least I should see what is happening". So he went to the plant doctors, watched and listened to other people getting and giving advice, and at the end of the morning asked for help with his bean disease. Their response was immediate: they should go and see the beans, the same day. The group involved farmer neighbours, the plant doctor and the Assistant Agriculture Officer. They confirmed the disease as a fungal infection, and after a long discussion, they suggested using Mancozeb, a fungicide which had to be sprayed only twice at an interval of 5 days. One month later Rahim returned to the plant clinic, carrying a big jute bag full of freshly harvested beans, which he gave as a gift to the plant doctor Piyera Begun and her colleague Anjuara.

In Demajani, as in many other rural areas, the plant doctors are not always agronomists. They may be village women who receive moral support and backstopping from agronomists. The women plant doctors are locally elected municipal leaders, who feel that the clinics give them an added opportunity to advance the development of their community. A similar example has been seen in Vietnam, where villagers are organising themselves to become "tree nurses", ready to report any problem which might arise.

Table 1. A network of plant clinics

Country	Number	Started	Managed by
Bangladesh	22	2004	RDA Bogra, AAS and Shushilan
Bolivia	6	early 2004	CIAT/Santa Cruz, Proinpa and UMSS
D.R. Congo	8	March 2006	Université Catholique du Graben, Butembo
India	2	August 2006	GB Pant University of Agriculture and Technology
Nicaragua	13	March 2005	Farmer organizations, NGOs and INTA. Support network: Funica, Promipac, Cnea, INTA and Dgpsa-Magfor. Funded by ASPS II (DANIDA), IFAD and other donors
Uganda	3	July 2006	Socadido, SG2000, Caritas and MAAIF
Total	**54**		

Experimenting in Bolivia

In August 2006, Virgilio Trujillo, a farmer in his fifties strode into the plant clinic organised by the San Simón University in the Chapare region, Bolivia. He came with a leaf from an orange tree. It was turning yellow, and he asked what was wrong with it. Virgilio has a large orchard, and all of the trees were turning yellow, except for two which were yielding fruit. He had concluded that "the land is all the same, so the difference must be in the plants."

The plant doctor, agronomist Fredy Almendras, listened carefully and looked at the leaf again, noticing how it was turning yellow between the veins, while the veins were still green, as though the plant was not getting enough nutrients. He also saw little flecks of algae on it, and realised that it was an old leaf. There was nothing really wrong with it, so he suggested paying attention to the soil. Virgilio almost lost his patience. He explained again that the problem was in the trees and not in the soil, because the soil was all the same, and because two trees were doing fine. So the plant doctor said that maybe the soil seemed all the same, but perhaps there was a little difference in the spots where those two trees were thriving.

Virgilio was listening, but didn't seem convinced. The plant doctor thought that a solution could be to prune back all the trees, and fertilize them, but he knew from experience that the man might be reluctant to practice such drastic advice. So he recommended an experiment to diagnose the problem, which the two men discussed thoroughly. "Take two branches from the orange trees that are producing well. Graft those branches into two other trees. If they still bear fruit, it means that the trouble is in the trees. Take two other trees that are not doing well, and fertilize them. If they start to bear fruit it means that the problem was in the soil." Virgilio left, obviously pleased with this advice: a practical experiment he could do on his own.

Conclusions

Conventional extension works with groups or individuals, often selected by an agency, and most of the other villagers do not receive attention. With plant clinics, any member of the community can get a diagnosis and advice. The farmers are in control of when to come to the clinic and when to leave. Some of the plant doctors are farmers themselves. One does not have to know everything to be a plant doctor, but it helps to be a good listener, and to be linked into a network that can share samples and information between farmers, agronomists, researchers and labs.

Having a successful plant clinic does not take much money. You do need a comfortable spot in a farmer-friendly place. It is important to be at the same place every week, at the same time. Books and photographs help people to talk about their plant problems, but you do not need a microscope or other fancy equipment. Have a sign or banner in the local language. Encourage people to bring in samples of unhealthy plants. A plant doctor often learns as much by listening to people as by looking at the symptoms. Only by listening can you learn that the plant may have been over-watered, damaged by herbicide, or may be receiving too much sun (or too much shade). Solutions are then easier to find. ■

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Rats: An ecologically-based approach for managing a global problem

Steven R. Belmain

Many people have problems with pest rodents. Rats eat our crops, contaminate our stored food, damage our buildings and possessions and spread dangerous diseases to people and livestock. Compared to insect pests, controlling rats and mice can seem difficult. Experience has shown, however, that armed with the right knowledge and tools it is possible to sustainably reduce pest rodent populations in a cost-beneficial way. In recent years, applied research on ecologically-based rodent management (EBRM) has taken place in many countries throughout Asia and Africa, involving a number of research and extension institutions working together in collaboration with farming communities to develop effective, sustainable and cost-beneficial rodent

Photo: Author

The dangers of rat infestations are not always recognised – nor is the presence of rats effectively dealt with. Urine and faeces frequently contaminate stored food.

management strategies. This article draws on the knowledge generated from these research and extension experiences, focusing on work carried out in the villages of Jakunipara, Sowara, Sahapur and Anandapur, all of them in Comilla, Bangladesh. We worked in partnership with the NGO Association for Integrated Development, Comilla, and with scientists from the Bangladesh Rice Research Institute, Australia's CSIRO and the U.K.'s Natural Resources Institute.

Identifying the problem

Like many countries, Bangladesh has a poorly documented problem with rats. Facts on crop yield losses caused by rats are hard to come by. Prevalence of rodent-borne diseases, such as leptospirosis or typhus, is unknown. And information regarding the impact of rodents on stored food through losses and contamination is simply not collected. What we do know is that almost any agricultural crop is attacked by rodents, and they are known carriers of more than 60 life-threatening diseases. Reducing crop damage by rodents not only improves food security and nutrition, but can lead to increased income. Reducing post-harvest loss and food contamination by rats improves health and nutrition, as well as lowering disease transmission.

Another common problem when dealing with rats is that there is often no clearly expressed demand for rodent control. Many rodent problems are not well understood by villagers, and the traditional methods of managing rodents are rarely adequate, so that villagers often just accept the situation. So, one of the big problems in developing better rodent management strategies is to understand their true impact on people's livelihoods. Providing people with the true cost of rodents on their livelihoods allows them to consider how much they can invest (traps, poisons, labour) in controlling rodents. Providing communities with appropriate management tools and knowledge about the rodent pests affecting their livelihoods, allows them to successfully manage their rodent pest problems in a cost-beneficial way.

Ecologically-based rodent management in practice

There was much anecdotal evidence of rodent pest problems in Comilla, but there was a need to show the actual impact of rats on people's livelihoods. Research activities showed that 5 to 10 percent of stored paddy rice was lost to rodents over each 3 month storage period, with each farming household losing an approximate of 200 kg per year. In common with most of Asia, most Bangladesh farmers stated they plant about 2 rows of rice for the rats for every 8 rows sown. Our assessments showed pre-harvest losses from rats ranged from 5 - 17 percent in irrigated and rain-fed rice fields. Farmer damage assessments highlighted some of the more overlooked impacts of rodents, namely physical damage to houses, personal possessions, roads and fields.

Through surveys and questionnaires with farmers and community members, we were able to assess the effectiveness of existing rodent management actions carried out by farmers and households. In common with most countries, Bangladesh farmers had access to some rodent control tools and methods. However, because they were not used properly, or were not well-adapted to local situations, they were often not very effective. This led to apathy and widespread acceptance of rodent pests in the environment. Rodenticides are frequently used to control rodents. Misuse of these poisons is unfortunately common. More importantly, when a rodenticide is not used correctly, it may not significantly reduce the rodent population. Other rodent management methods involving trapping and environmental management can be more appropriate for the rural and peri-urban situations found in developing countries. Adopting an ecologically-based rodent management strategy is increasingly seen as more sustainable, both economically and environmentally, than the traditional use of acute poisons.

Step one: Know your enemy

As with any IPM strategy, the main principle is to "know your enemy". Not all rodent species are the same; each species has different breeding rates, habitats and species-specific behaviours. These factors will affect their pest status and the methods of control. For example, some rats like to live up high in trees or the roofs of people's houses, while others like to burrow in the ground or the walls of mud-brick houses. Knowing where rats live is important when targeting control actions.

Rodents are also highly adaptable, and the same species may exploit different foods or habitats when found in different environments. Once armed with the basic knowledge about the rodents, where and when they cause damage and the types and extent of damage caused to different crops, stored food and health, it becomes possible to address all the problems rats cause in an integrated way. This information improves peoples' understanding of the costs of doing nothing about rats on their livelihoods and allows an assessment of potential cost-benefits when developing a management strategy.

Step two: Know your end user
In addition to understanding the local rodent biology and ecology, EBRM must also consider the knowledge, attitudes and practices of the people affected. Effective rodent control practice must be based on the financial and time constraints of the people suffering from rodent pest problems. Rodent-human interactions can be complex, with rats seen as food, pests, and even involved in witchcraft or religious beliefs. Understanding existing practices and knowledge helps in the design of a strategy that will be locally acceptable and sustainable.

For example, few small-scale farmers understand the difference between acute and chronic rodent poisons, and will often choose acute poisons as they see dead bodies in the morning, which they rarely see when using chronic poisons. However, chronic poisons can work well and effectively reduce pest populations, but the effects are not so clearly seen as the poisoned rodents die in their burrows.

Step three: Know your technology
The use of rodenticides which work by interfering with blood clotting remains a powerful tool, particularly in urban environments and for large-scale agriculture. However, their financial and environmental sustainability is questionable for the majority of situations found in rural and peri-urban communities engaged in small-scale agriculture.

Because rats are mobile, moving over large distances in their daily foraging, the main principle of ecologically-based management is that farming communities must act together. Individuals acting on their own in their house or crop field will have little impact on the overall rodent population, with rats quickly migrating back into areas from where they have been removed. This implies that communities must coordinate and communicate effectively over a large scale, and it is important to encourage high levels of community cohesion for EBRM to be successful. This can be a challenge, particularly in more peri-urban situations. The cost-benefits of working together for rodent management means that individual investment costs are low, as the overall effort is shared by many. EBRM must therefore be a community-based effort.


Photo: Author

A group meeting in Jakunipara: farmers tell what they know about rats and decide together what to do to control them.

Reducing the rat population through intensive trapping is labour intensive, but requires a smaller financial investment compared to the continual purchase of rat poisons (as traps can last for many years). Nearly everyone is familiar with the principles of rat trapping, and often several indigenous trap designs can be found locally. However, not all traps are the same, with some designs working far more effectively than others. Good quality traps may not be locally available, and this may need to be addressed at market and policy levels to rectify. The main principle of intensive trapping is to remove rats from the population faster than their breeding rate. Because rats breed very quickly, this means that intensive trapping must continue on a daily basis over a long period of time, with traps spread over a sufficiently large area.

Our activities in Bangladesh showed that we could dramatically reduce the rat population by more than 80 percent. This was largely achieved by communities managing a system of daily rat trapping throughout their village with about 50 percent of households trapping daily with one or two high quality kill traps. The position of the traps would rotate around the village so that every household would be involved. With continual daily trapping, the rat population crashed after 2 months and remained low as long as daily trapping continued across the village.

Another trapping technology that has been developed and used effectively in small-scale agriculture is called a Trap Barrier System. This works by enclosing a "lure" crop within a rodent proof fence that attracts foraging rodents. Multiple capture live traps are placed within the fence so that rodents are drawn to the lure crop and become trapped when trying to get near the food. Many rodents from the surrounding crop fields are attracted, effectively clearing a large area free from rodent pests, with many farmers benefiting from a single trap barrier system. Certain criteria must be fulfilled for this system to work effectively: crops must be grown at more or less the same time in adjacent farmer fields so that an early ripening lure crop can be planted within the trap barrier system. The farming community must act together to spread the investment costs of constructing and managing the system.

Rat populations can also be reduced by permanently changing the environment and the availability of food, water and nesting places that rats need to survive. These actions are commonly referred to as environmental management. They can be particularly effective when aiming to stop rodents sheltering near to human living areas, and eating stored food and water meant for immediate human consumption. For example, this may involve rodent proofing on-farm grain stores, or ensuring that locally stored water is adequately covered to prevent rodents eating, drinking and contaminating food and water with their urine and faeces. Many diseases carried by rodents occur through contamination of food and water, so environmental management must be accompanied by local education programmes to raise awareness about the risks of rodent diseases. Environmental management can also involve activities that reduce places that rodents can eat and live around villages, e.g. by ensuring that rubbish is cleared away, and removing rubble or vegetation far away from human living areas. Good sanitation can really make a major difference in the number of rodents living close to people, reducing rodent impacts on livelihoods.

Photo: Author

Not all pest species are the same. Knowing your enemy is the first step of a successful pest management approach.

Finally, in addition to population reduction and environmental management, there are actions that reduce people's exposure to rats without, perhaps, doing much about the rat population itself. Removing contact and exposure to rodents and the diseases they carry can be achieved by the actions described above, but also by encouraging and educating communities about basic hygiene, such as frequent handwashing with soap. For example, in many communities rats are hunted and eaten as an important food resource. Considering the many dangerous diseases carried by rats, the way they are butchered and cooked can have major negative implications on human health. It would be foolish to discourage people from eating rats where protein sources are scarce, but improving hygiene standards to make rats safer to consume can be achieved through demonstration and education.

Monitoring the costs and benefits of EBRM

The initial stages of implementing EBRM are often challenged with a lack of interest and doubt in local farming communities. This is because small-scale farmers who have tried to control rodent pests usually see very little benefit, often because their actions are ad-hoc, one-off, and unco-ordinated. And as is generally the case with any pest management, such actions are too little, and come too late. Farmers can, therefore, take some convincing that rodent pests can be cost-effectively controlled. And as communities have rarely experienced what life can be like in the absence of rodents, the true impact of rodents on their lives is usually grossly underestimated. A final challenge in implementing EBRM is encouraging communities to assess success by looking at the changes in their lives, and not only at the number of dead rodents they have collected. These challenges favour education and extension programmes that strongly focus on demonstration and community participation.

Our work with EBRM in Bangladesh showed a reduction in the impact of rodents by 60 – 80 percent for different measurable indicators. This was established through comparing intervention villages with non-intervention villages. Similarly, farmer assessments showed that these strategies cost about the same (in terms of money and time) as the former practices, but with a much higher benefit. As a result, the 3-step approach is now being extended widely through southern Africa via the Ecorat project (http://www.nri.org/ecorat). Once basic information is collected about the rats, end users and management tools, EBRM can be developed for a variety of local agro-ecological contexts. Once a few communities see the difference this type of management makes to their lives, up-scaling and dissemination to other nearby communities can occur through traditional extension channels. Rodent pests have been a largely neglected problem in the developing world, but an ecologically-based approach can triumph where poisons alone have failed, particularly when communities work together to overcome the multiple impacts of rodents on their lives.

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Changing the strategies of Farmer Field Schools in Bangladesh

Hein Bijlmakers and Muhammad Ashraful Islam

The Farmer Field School (FFS) approach was developed in the late 1980s in Indonesia, as described in *LEISA Magazine* Volume 19.1 and many other publications. This agricultural extension method was originally designed to educate rice farmers about the concept of biological control, and to familiarise them with Integrated Pest Management (IPM). Following the successes of this practical and participative method of farmer education, it quickly spread to other rice growing areas in Asia. Within a few years, FFSs were also used for other subjects such as IPM in vegetables and cotton, animal husbandry, and even subjects that are not related to agriculture.

In Bangladesh, the first Farmer Field Schools were organised in the early 1990s, assisted by the FAO inter-country programme for IPM in rice. After initial positive experiences, several other donors (UNDP, CARE-Bangladesh and DANIDA) started projects to spread IPM to hundreds of thousands of farmers through IPM Farmer Field Schools. All these projects included season-long Training of Trainers courses to develop skilled FFS facilitators. Through this continuous support over the past ten years, Bangladesh now has a huge capacity to implement FFSs, especially in the Department of Agricultural Extension (DAE).

Initially, FFSs organised by DAE followed the "original" rice IPM FFS curriculum to a large extent, with a strong focus on managing pest problems and with the aim of reducing pesticide related problems. Over the years, however, the curriculum has been revised and improved several times. DAE is currently running a five-year programme to organise 8000 Farmer Field Schools for Integrated Crop Management, with financial and technical support from DANIDA. The Integrated Crop Management FFS curriculum differs in many aspects from the original IPM FFS curriculum. This article focuses on the reasons behind these changes, showing the experiences so far and the issues that still need to be addressed.

Weaknesses and opportunities

The original IPM FFSs were successful in reducing pesticide related problems. IPM-trained farmers use less pesticides and often have small increases in yield compared to untrained farmers. However, even though the objectives of reducing pesticide use and increasing yields were reached, there were still issues to be considered in improving the livelihoods of these farmers.

Women as FFS participants

Growing rice in Bangladesh is usually done by men, while women are involved in various post-harvest activities (threshing, drying, winnowing and storage). The original IPM FFSs, with a focus on pest management and a goal to reduce pesticide problems, therefore addressed almost only male farmers. It was indicated, especially by the donors, that more efforts should be made to involve more women in the FFS training programme. Initially, this was done by starting vegetable IPM FFSs, since it was expected that more women participants would then be included.

This was true – more women participated in the vegetable FFSs. However, it then became clear that the vegetable IPM curriculum, which was very similar to the rice IPM curriculum, was not addressing the real needs of these women. Actually, these women were involved in homestead growing of vegetables, a low input situation with very little pesticide use. The commercial vegetable plots, with higher inputs of fertilizers and serious pesticide misuse, are usually grown by male farmers. It was clear that a move from rice to vegetables alone was not sufficient, and that the FFS curriculum would need more changes to address the actual needs of women. At the same time, there were a number of social barriers preventing more women being in the FFSs. This was particularly an issue in the more conservative communities, and it led to the idea that perhaps both the man and the woman from the same household should be invited to the training.

Soil fertility and fertilizer management

One of the principles of IPM is to "grow a healthy crop". The rice IPM curriculum is not only about pests and beneficial insects, but it also includes topics on seed quality, variety selection, fertilizer management and water management. After many years of IPM FFS implementation, it was concluded that the curriculum did not give sufficient attention to soil fertility and fertilizer management issues. Positive experiences obtained in another project were then used to include more soil and fertilizer related topics in the curriculum. Simultaneously, other curriculum adjustments were made to pay more attention to seed quality and seed production. As a result of all these curriculum changes, the name was changed from IPM to Integrated Crop Management (ICM), showing the more holistic approach to crop production.

Sustainability

With the scaling up of the FFS programme in Bangladesh, a lot of attention was given to studying the impact of the training and to evaluating how farmers' behaviour changed over the years. Results were quite positive and showed that several years after attending an FFS farmers still remembered what they had learned, and their practices remained better than those of untrained farmers. During these evaluations and impact studies it was also found that in some cases FFS farmers have continued working as a group and have formed a kind of farmers club. They continued meeting with each other, discussing their crop management problems, and trying to develop solutions together.

This was then seen as an opportunity for increased sustainability. Pilot activities were started to give support to these "IPM clubs". Within a few years it became clear that these clubs can be much more than an extension of the FFS. Often these clubs grow and help spread the IPM message to neighbouring farmers. Some clubs even developed various income generating activities (not necessarily IPM or ICM related), or social activities that contribute positively to community development.

These positive experiences with clubs have lead to an important shift in strategy. Forming long-term farmer clubs has now become one of the objectives of the ICM FFSs in Bangladesh. The FFS curriculum is now designed to work towards club formation, right from the start. When clubs are officially registered and properly organised they can even develop into community based organisations.

The ICM FFS curriculum

Considering the weaknesses and opportunities described above, the original rice IPM FFS (with 25 male farmers and 14 weekly sessions) has gone through a number of revisions. In the current ICM FFS the participants are 25 male farmers (rice growers) and 25 women from the same household. The FFS curriculum has been expanded from 14 to 20 sessions and now includes:

- One inaugural session, for men and women together;
- Eleven sessions for men only, which follow a similar approach as the IPM FFS curriculum. During these sessions there is still a lot of attention to pest management, but with an increased emphasis on seed quality, soil fertility and fertilizer management and with several field studies related to these topics. The curriculum reflects a holistic ICM approach to crop production;
- Four sessions for women only, with topics that were specifically developed to address the needs of women and with the objective to improve the nutritional status of the household. These sessions include: creating awareness on a balanced human nutrition, developing homestead vegetable gardens, planting of fruit trees, the use of farm yard manure, and improved stoves;
- Four sessions for men and women together, which are used to develop farmer clubs. These clubs will continue the group work after the FFS sessions are completed, with new activities for men and women in the community; and
- A field day organised by male and female participants of the FFS.

If the completed FFS has formed a club, there will be more support in the season after the FFS through a number of follow-up sessions. Topics for these sessions are selected by the farmers, while the FFS facilitators help in identifying resource persons to conduct them (see Box 1).

Box 1. Learning continues after the FFS

In the season after the FFS farmers form a club which receives some funding for additional training sessions. Topics are selected by the farmers and can include a wide range of subjects such as beekeeping, beef fattening, quality seed production, family planning, poultry rearing or grafting of fruit trees.


Photo: Hein Bijlmakers

An FFS session on rice-fish culture. The IPM club involved is planning to grow fish in small ponds attached to their rice fields.

Farmers as facilitators

Another development which has taken place in Bangladesh since 2000 is the involvement of farmers as facilitators. These farmer facilitators, often referred to as Farmer Trainers (FT), are farmers who proved themselves as capable to lead other farmers during an FFS. Various criteria are used to select potential candidates (see Box 2), who will always work together in pairs. After completing their FFS, they first receive an additional training of two or three weeks. During this time they learn skills that help them facilitate FFS sessions and organisational skills to manage an FFS. Then, for an entire season, they work with DAE facilitators as apprentices in an FFS in their locality. After this season-long practical experience they are then ready to organise their own FFS as a facilitator.

The FFS organised by farmer facilitators follows the same curriculum and operates with the same budget as an FFS organised by government extension facilitators. Although there was some concern about quality, it was soon found that in many cases the farmer facilitators even perform better than the government extension facilitators, provided that the selection of farmer facilitators is good. Another advantage of farmer facilitators is that they are attached to the farmer clubs, which means that apart from being involved in starting new FFS they also play important roles in supporting their own club activities.

Remaining issues

We have seen that FFSs in Bangladesh in the past ten years have gone through a number of changes and developments, many of these contributing to better learning opportunities for men and women participants. But there are still many issues that need attention, and further improvements and developments will take place in the coming years. The present curriculum will be updated yearly, based on new field experiences. Here are some of the issues that still need attention:

- With each change in the FFS curriculum there is a risk of losing quality. Newly introduced topics need to be field tested and adapted until they can be presented in a participatory and practical way. Introducing new topics in the FFS can also create time constraints, reducing the time available for activities such as an agro-ecosystem analysis and participatory decision making.
- The current ICM FFS includes four meetings where 25 men and 25 women are present. This is a very large group, which makes it difficult to have real participatory discussions and decision making.
- Currently there are just four "women only" sessions in which a lot of different topics are covered, which all suffer from time constraints.
- The cost of training is an important issue and FFS have often been said to be too expensive. FFS in Bangladesh currently cost around 40 000 *taka* (425 euro) for the 20 sessions and a field day. With 25 men and 25 women benefiting from this training the cost is 8.5 euro per participant. In addition there is a 4000 *taka* (43 euro)

A farmer facilitator conducting an FFS session in rice on the use of the Leaf Colour Chart.

Box 2. Farmer Trainers

A large number of qualified FFS facilitators are needed to reach the millions of farmers in Bangladesh. Skilled and motivated farmers are now working as FFS facilitators side by side with government extension facilitators of the Department of Agricultural Extension. Many of these farmer facilitators are women. Farmer facilitators communicate easily with FFS participants because they often know each other personally.

Capacity building of farmer facilitators is a future investment for scaling-up processes. Therefore the selection of farmers is done in close consultation with government extension facilitators who are responsible for the area and they are interviewed by experienced master trainers based on criteria that should ensure their quality and long-term commitment. A first criterion is that they have to be full-time farmers who live in the locality and who are members of an ICM club in their village. They should also have a very good understanding of ICM concepts. They should be literate, have good organising capabilities and leadership skills, and should show a strong interest in the social welfare of their community. They should be healthy and at least 25 years old.

Farmers who are selected to become farmer facilitators sign a contract in which they commit themselves to be available for a Training of Trainers course and to become active facilitators for organising new Farmer Field Schools.

support for farmer clubs to organise learning sessions in the season after the FFS, which is less than 1 euro per club member. While these costs are low in relation to the benefits, it is important to look at opportunities for cost reduction while maintaining quality. Some costs (a small snack during each session, and a cap for each farmer) could be saved without affecting the quality of the training, although these are highly appreciated by farmers.

- Season-long Training of Trainers courses to develop FFS facilitators are expensive, lengthy and time consuming. For DAE it is difficult to release their field staff for a period of three to four months to participate in these season-long courses. However, it is considered important that the training should cover an entire cropping season. Therefore, the programme is now piloting a new Training of Trainers system where two groups of participants rotate in spells of two weeks. During a TOT of 24 weeks, each participant would attend six blocks of two weeks. Experiences with this system will have to be evaluated if it delivers good facilitators.
- The FFS approach is also going to be adapted for fisheries and livestock in other government departments with support from the programme. Collaboration between different departments will be one of the opportunities and challenges for the coming years.

The FFS model is based on experiential learning. The programme in Bangladesh has observed that running a large scale FFS programme is also an experiential learning process. Season after season adjustments are being made based on new experiences and on feedback from farmers and facilitators. ■

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Our experiences with modified Farmer Field Schools in dryland areas

Arun Balamatti and Rajendra Hegde

Photo: S. Jayaraj

A broad approach to pest management is needed in dryland areas. This needs to be taken into account in the FFS curriculum.

The Farmer Field School (FFS) approach has become well-known after the positive experiences seen in Indonesia and other Asian countries. In many ways, however, it lends itself more to addressing the pest problems of farmers in irrigated agriculture than in dryland farming. In the latter, pests and diseases are only a part of the farming problems, often less crucial than in irrigated farming; and they need to be seen in relation to many other aspects. In this article we describe how the "conventional" IPM Farmer Field School approach has been modified in the South Indian dryland agriculture context, in order to suit the needs and problems of farmers in this area.

Transforming the FFS approach to suit dryland farming

The AME Foundation, with the assistance of FAO, has made a concerted effort to innovate and adapt the conventional FFS approach. AME is a support NGO working in the southern Indian states of Andhra Pradesh, Karnataka and Tamil Nadu. It works with groups of farmers in clusters of villages, where it promotes the use of LEISA technologies with participatory tools. Alternative farming practices are scaled up through and with NGOs and NGO networks. The capacity building of farmers and of NGO staff therefore constitute its major activities.

AME has been using the FFS approach since the late nineties. In 2005, with the initiation of a partnership project with FAO, the process of adapting and transforming FFS process and contents was given a further boost. The key challenge was to transform the contents' orientation, which was mainly on the plant–ecosystem relationship, to the interrelated aspects of rainwater, soil fertility, crops and cropping system management and biomass, in a wider livelihoods context. Another challenge was to organise the entire capacity building process in such a way that it would be possible to achieve maximum up- and out-scaling of the FFS contents, without diluting the quality of the learning experience. AME thus embarked on a "Modified Training of Facilitators" programme (MToF) in Dharmapuri, a district in Tamil Nadu, in partnership with MYRADA, a large local NGO. This programme aims to train facilitators who can independently conduct FFSs in a dryland context. About 2500 Self help Affinity Groups (SAGs) have been organised in this area, and these in turn have formed eighteen Community Managed Resource Centres (CMRCs), with the basic objective of being a "service provider" for the development needs of the member SAGs. In total, nearly 40 000 families are involved. This offered an excellent platform for the large scale promotion of LEISA approaches in dryland farming.

Content innovation

Groundnut is the major crop grown in Dharmapuri under rainfed conditions. While the average yields are poor, pests and diseases are only one of the problems which farmers face. The inadequate rainfall and its poor distribution, poor soil fertility and inappropriate agronomic practices are also key problems. AME therefore decided to bring these issues into the FFS curriculum. The discovery learning and experiential learning opportunities stretched beyond the crop-ecosystem interaction; in fact, an attempt was made to address livelihood improvement in the drylands, which encompasses crop husbandry and related activities. Short studies and long-term experiments were designed around *in situ* rainwater conservation, improving soil fertility and modified cropping systems. Support activities like biomass generation, kitchen gardening, the cultivation of azolla, livestock management and vermicomposting were included to ensure that the programme was "livelihood" focused in addition to being "crop" focused.

Insect zoos and studies normally form part of the IPM Training of Facilitators curriculum, along with an agro-ecosystem analysis (AESA). In our "Modified Training of Facilitators" we included several new studies and experiments:

1. Soil moisture management: Various simple experiments were designed for assessing and measuring the soil's physical properties, the erosion, the water infiltration rate and water holding capacities, and the effects of preparatory tillage;
2. Soil fertility improvement: Experiments were also designed to determine the effect of enriched farmyard manures, *in situ* green manuring, composting and vermicomposting;
3. Modified cropping practices: We also considered testing the viability of the groundnut seed (after removing the seed coat), its germination, the different methods of sowing, the optimum sowing depth, and practices such as strip cropping;
4. IPM: Pot experiments were included, looking at the role of *Rhizobium*, the uptake of nutrients, the effect of inorganic fertilizers on soil micro-organisms, the effect of *Trichoderma viridae,* different options for intercrops and trap crops, the efficiency of bio pesticides and the calculation of the leaf damage area, among others; and

5. Support activities: Finally, we also included a series of support activities, such as establishing kitchen gardens, making silage and mushroom production.

Process innovation

An extension approach can only have an enduring impact if it can be scaled up. Initial FFS experiences have been mainly built around governmental extension systems; the underlying assumptions being that extension is a governmental responsibility, and that the government extension system has a larger coverage. However, as governments became interested in the FFS approach, its philosophy has often been diluted, and after a few years not too much remains of its original learning-oriented spirit.

The AME Foundation decided to follow a different approach. It chose to work with NGOs which reach large numbers of community-based institutions. Rather than training the government or NGO extension workers, we decided to look to the communities as the starting point for up-scaling. Young farmers linked to the CMRCs were included in the training courses; the aim was to make the FFSs an integral part of the service provision package of these centres. The conventional Training of Facilitators, involving five-day classroom sessions and one-day practices, was changed to three days of classroom sessions followed by three days of practical work. The "practice FFS farmers", in turn, adopted 3 to 5 farmers to share their learning. In this way, it has been a three-level learning opportunity for the participants: one, as participants, they learn the skills of facilitation; two, by conducting "practice FFS", they get "hands-on" experience of facilitating FFS with the farmers. And finally, by helping the "practice FFS farmers" adopt more farmers, the participants could obtain feedback from the fellow farmers to ensure the curriculum is always need-based. This way, it has been an educational investment to prepare FFS trainers and, simultaneously, an extension activity to involve more farmers in FFS.

During the last few years, 32 Community Resource Persons have been trained in the FFS methodology; nearly 900 farmers have been directly involved in the "practice FFS", with more than 1300 farmers being involved indirectly. These activities have created space for the participation of a large number of women, in some cases making up to 90 percent of all participants.

The adoption of certain practices implied that the new studies within the Modified ToF curriculum were found useful. Vermicomposting, kitchen gardening and the production of azolla became instantly popular among the "practice FFS farmers". A recent study conducted by FAO and AME on the impact of the "Modified Training of Facilitators" on participants' livelihoods revealed that the FFS training has improved participants' skills and abilities. The FFS training has strengthened women's knowledge and skills on soil and water conservation, soil fertility management and better practices of crop production and protection. The availability of food crops for home consumption has improved. FFS farmers have earned a remarkably higher income from agriculture as a result of improved management of their fields. FFS training has also enabled women to be better decision makers, particularly in the area of livestock management.

The way forward

Our experience has shown that it is possible to adapt the FFS approach to a dryland context, effectively tackling pests and diseases, though as part of larger set of problems. In the IPM Farmer Field Schools the emphasis is on growing a healthy crop, whereas in a dryland FFS, the facilitators have to skilfully use this principle in its broader farming system perspective. The FFS approach can be an empowering tool in a dryland farming context, provided the facilitators have the sensitivity and skills to design learning exercises for farmers that focus on location-specific technologies relevant to their specific context.

Similarly, the process suggests that it is possible to upscale the FFS approach, provided there is a sound base in the form of community-based institutions. This year, the AME Foundation is running nearly 600 FFS events in 13 different cropping systems, covering over 10 000 farmers in 500 villages, 11 districts and 3 states. This level of up-scaling could not have been achieved without the local organisations. Among the lessons we have learnt in the process:

- A thorough understanding of livelihood systems is necessary for developing a broad-based FFS curriculum. The continuous interaction of the facilitators with farmers, research and extension agencies enriches the curriculum;
- Larger farmer outreach is easier if there are organised groups close to the training location. The existence of such organisations is likely to be a condition for the sustained impact of FFS;
- Training events, proper planning and preparations for the "practice FFS" and receiving feedback after the sessions are crucial steps. They need to be properly managed, or else these could eat into the precious little time available for classroom sessions;
- While the ToF events requires intensive involvement of both facilitators and participants, the overall cost of the ToF and the follow up FFS events becomes justified, keeping in mind the substantial farmer outreach.

AME plans to evaluate this process again at the end of the 2007 season. It is expected that the effectiveness of the programme will depend to a large extent on whether and how the CMRCs will continue to use the services of the trained FFS facilitators. Regular monitoring and refresher courses for updating the facilitators' knowledge and skills are essential to maintain the impact of FFS in future. If these Resource Centres are able to provide sustained follow-up to the FFS, with minimum external support, it will mean that FFS can become an effective, affordable and sustainable extension strategy in dryland agriculture.

■

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Photo: Author

Working together while experimenting with pest management has given women more confidence.

Integrated pest control for empowering women farmers

Hery Christanto

Kemiri is a village in Kepanjen subdistrict, Malang, East Java, Indonesia. Farmers cultivate corn, soya beans, peanuts and vegetables, but their main crop is rice. However, rice productivity in Kemiri has not been constant recently, fluctuating with the seasons and the weather. In the past two years, pests and diseases have caused serious damage to rice in June and July. The main pest is white rice stemborer (*Scirpophaga innotata*). In the first rice growing season there were two infestations, at the vegetative and reproductive stages. To control infestations during the vegetative phase, farmers applied additional urea to induce growth, but the plants died, and the farmers replanted the fields. Infestations of rice stemborers occurred in almost every paddy field: between March and May there was an average decrease in rice yields from 6.5 tons/ha to 4.5 tons/ha. Efforts by the farmers, including spraying pesticides and applying extra urea, proved fruitless. This condition persisted for two years.

Although 65 percent of the inhabitants of Kemiri are farmers, they do not rely totally on farming to make a living. The village is close to the subdistrict capital, Malang, so many (mostly male) farmers also work in the city. They do whatever work they can get, earning money as building labourers, street vendors, or school guards. After they have planted rice they go off and come back at harvest time, which means that the male farmers do not pay much attention to the state of their rice crops. Not many farmers' children are interested in farming, either. So only the women who remain in the village take care of the rice fields.

Farmers learn about integrated pest control

Puzzled by the damage to their paddy fields caused by rice stemborers, five women farmers turned up at the agriculture extension office in Malang. At that time, LPKP Malang, a local NGO, along with several agriculture extension workers from the local agriculture extension office, were setting up a demonstration plot to experiment with different rice growing systems. The five women farmers then asked the NGO and the local agriculture extension worker to help them solve their problems.

Integrated pest control activities in Kemiri began with a field survey and preliminary analysis of the damage caused by stemborers. After that it was agreed that this problem would be discussed at weekly meetings in the paddy fields. Over the weeks, the number of farmers getting together to discuss how to deal with the stemborers grew from 5 to 20. As Lisriani and Atun, two farmers who attended these meetings, said, "We now know that the pesticides we've been using don't help at all; in fact they make matters worse. We always thought of pesticides as medicines for plants, but the integrated pest control activities have show us that pesticides are in fact toxic, not only for the pests, but for us, too."

A different topic is discussed every week, all of which have helped farmers grow healthy rice plants. Discussions have centered around pests and their natural predators, insect decomposers, how to produce healthy seeds, how pesticides affect pests and natural predators, how to perform analyses of agroecosystems, and also around the strategies for controlling rice stemborers without the use of pesticides. Every week, the farmers look at how to control the incidence of stemborers, grow healthy crops, improve soil fertility, make organic fertilizer, and how to manage water in the paddy fields.

Local experiments

"At the beginning we could not understand why the extension workers couldn't just give us a straight answer to the problems we were having with stemborers, and instead asked us to do an experiment. We just wanted a quick answer," said Jumiati, a group member. But after it was explained that pesticides were not the answer to rice stemborers, the farmers' realised the need to look for local-specific alternatives.

Experiments were done by the women's group on two demonstration plots of 1000 m^2. This land is lent to the group by one farmer member, so that all participants can practise and learn together. It is free of charge. The seeds and fertilizers were provided by the local NGO in co-operation with the farmers. The rice was sold and the money made was kept by the group. It is used to pay for trainings, and materials needed for meetings or exercises.

Each demonstration plot was planted with the same rice. The difference was in the way they were treated: one was treated with urea and other fertilizers in doses recommended by the agriculture extension office, and sprayed with pesticides; the other plot was treated using the integrated pest control approach, with applications of organic fertilizer (*bokashi*). It was also drained of water, and not sprayed with pesticides. The integrated pest control approach involved: using healthy seed, protecting and developing natural predators (natural control by creating a balanced field ecosystem) and weekly monitoring.

The integrated pest control activities were all done during a single rice growing season (3 - 4 months), from raising seedlings and land preparation, planting and maintenance, through to harvesting and harvest analysis. During this period, the farmers learned how to grow healthy plants, and understood that healthy plants are more resistant to pests and disease. They learned the difference between pests and natural predators, and about the food chains in a rice paddy ecosystem. They found that this can be used as a control strategy because pest outbreaks are caused by an imbalance in the ecosystem. They learned about the impact of pesticides on the environment, and that their residues are consumed by humans.

Weekly monitoring taught the farmers how to make simple, routine observations of the condition of the paddy agroecosystem, so that data from these observations could be used to formulate recommendations and action plans. The experiments each season varied according to the problems that the farmers were having and wanted to solve. These ranged from cultivation techniques to high yield rice varieties, the effects of pesticides on the environment, or water management (see for example Table 1).

Lessons learned

Farmers learned that pesticides are poisonous and that not all insects are bad for the crop. They saw that increased applications of fertilizers are not good for the soil. These experiments were done in cooperation between farmers, extensionists, NGO staff and university researchers. During the experiments, farmers' initial knowledge was taken into account, and any remaining questions that they had were explained and answered. As a result of this process, after 4 or 5 planting seasons, farmers are already expert enough to share their knowledge with other farmers. They are also "brave" enough to do other experiments on their own land. Farmers usually share such new knowledge and innovations through exchange visits or field days organised by extension or NGO staff. This enables other farmers to experiment and see if the method/innovation is compatible with their situation.

From the results of applying an integrated pest management approach over the past two years, the women farmers have learned several valuable lessons:

- The farmers are the experts on their own land. They are the ones who are able to explain why pests cause damage, how that damage manifests itself, and what action needs to be taken;
- The learning process has boosted the farmers' self-confidence. They trust the information which they have obtained from their field meetings and are happy to share it with other farmers. Atun and Lisriana, for example, have been on exchange study visits, and acted as resource people at many extension forums;
- The use of chemical pesticides and fertilizers is decreasing. This is particularly obvious at the farmer level. They have begun to shift from intensively cropped systems to ecologically cropped systems, slowly reducing the chemical use and gradually introducing semi-organic farming (no pesticides, no chemical fertilizers). Production is increasing with the introduction of new varieties;
- Having a simple monitoring system helps the farmers in building on their knowledge.

The activities of the women's integrated pest control group in Kemiri continue. These activities are becoming more interesting because the farmers are now able to enjoy their results: rice production has risen to 6.5 - 7 ton/ha. Income from the sale of rice has increased for two reasons: they spend less on buying pesticides, and use less seed (10kg/ha instead of 50kg/ha), another practice they learnt about during their meetings.

Gradually, this group is starting to develop organic farming by using rice cultivation techniques that do not use chemical pesticides and fertilizers, using the integrated pest control approach. In the long run, the integrated pest control approach provides a technical solution, empowers women and contributes to more sustainable and secure livelihoods for farmers. ■

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Table 1. Results of experimenting with zero pesticide techniques for controlling rice stemborers

	Propagation	Vegetative phase	Generative phase	Post harvest
Control strategy	- Collecting egg cases - Releasing parasitoids such as *Trichogramma* sp. in the seed beds - Using high-yield rice varieties	- Collecting egg cases - Propagating natural predators such as spiders - Developing lamp traps - Drying out the field (2-3 days) - Adding organic fertilizer (to induce growth of panicles)	- Propagating spiders - Developing lamp traps	- Burning rice plant stumps - Immediate soil management and flooding
Focus topics to support learning	- Getting to know pests and their natural predators - Effects of pesticides on natural predators in the seedling beds - Hatching of rice stem borer egg cases	- Getting to know pests and their natural predators - Effects of fertilizer on panicle growth - Effects of pesticides on spiders - Effectiveness of lamp traps	- Effects of pesticides on spiders - Effectiveness of lamp traps	- Survey of the status of rice stem borer in rice plant stumps post harvest

FFSs in translation: Scaling up in name, but not in meaning

Marc Schut and Stephen Sherwood

After discovering the seriousness of pesticide problems in Carchi, Ecuador, farmers and their communities began to search for ways to decrease reliance on agrochemicals. In 1999 the Farmer Field School (FFS) methodology was introduced, of which early results were promising. Through participation in FFSs, hundreds of potato farmers discovered alternatives to pesticides and fertilizers, while maintaining high production levels. The associated decreases in costs meant better productivity – commonly a return on investment of 40 percent or more. Further, medical research showed that decreased exposure to pesticides improved health. As a result, FFSs became increasingly popular, and it was encouraging to see numerous farmer groups, NGOs, government organisations, and even private industry adopt the methodology. Nonetheless, our optimism proved short-lived.

Case studies of contrasting forms of FFS

We do not question the utility of people-centred, problem-based, self-discovery approaches to Integrated Pest Management (IPM), such as FFS. Nevertheless, we have concerns over how and why professionals and their organisations diversely apply such approaches, in particular when they emerge in forms that contradict original purposes. An earlier article in the Spanish edition of *LEISA Magazine* (Vol.19 No.1, June 2003) found a systematic erosion of the FFS methodology. As follow-up, between 2003 and 2006, we visited many FFSs and talked with participants, graduates, facilitators and Master Trainers. We documented numerous examples of FFS in practice and held meetings and workshops to identify reasons behind the changes to this approach.

As an illustration, we present three examples of how FFS came to be practiced in Carchi. In each case the individuals initially were acknowledged as outstanding FFS facilitators. Nevertheless, over time, different professional and organisational factors initiated a transformation of FFS. As a result, we do not believe that competency is the issue at hand. Instead, we believe the erosion of FFS to be the result of more subtle social matters.

Case 1: Donor demands

In November 2005 we visited an FFS "field day", organised by an Ecuadorian NGO and its donor agency in the village of San Rafael. Normally a field day takes place at the end of a cropping cycle, so that participants can share the results of their experiments and demonstrate what they have learned. By design, FFS participants take charge of the day. They choose topics for presentation and discussion, prepare information stands, and plan logistics. Nevertheless, this field day was organised prematurely – only one month after sowing the learning plots. When we questioned the facilitator about this, he explained that the period of financial support had ended, and to be compliant with the donor agency, he had to move up the event. As a result, the participants had not yet acquired the knowledge, skills, and confidence to run a field day on their own, so the facilitators had to take charge. Contrary to FFS designs, the facilitators determined the topics, prepared the materials, and gave most of the presentations.

Photo: Marc Schut

Empty pesticide package found in the FFS learning plot.

The messages of the field day ended up being a confusing set of presentations that produced contradictory messages to the central purpose of this FFS – decreasing reliance on agrochemicals. The presentations focused on the promotion of pesticides, rather than explaining how joint learning and an agro-ecosystem analysis (AESA) could help farmers reduce the need for pesticides. Nor was there attention to how experimentation could support farmers to discover alternatives to agrochemicals, such as insect traps. During the field day we found an empty pesticide package in the learning plots (see photo), which for us symbolised the field day's confusing content and messages.

Case 2: The preferences of an individual extensionist

In December 2005 an NGO partner established a Farmer Field School in the village of Yascón. A week before the facilitator had been in the community to explain about the methodology and to recruit participants. He said he was asked to establish this FFS in order to meet his organisation's quota of four groups. By design, the facilitator and participants should choose the focus crop together, based on the results of a participatory diagnostic. In this case, the facilitator predetermined that the FFS would work on *frijol* (common field bean).

Instead of co-selecting the learning plots, preparing the soil and sowing the plants with the participants, the facilitator determined that the learning plots would be a five-week old bean field found outside the community. Additionally, the participants had explained that due to their heavy workload during the week, they preferred to hold sessions during the weekends. But the facilitator refused, arguing that he did not work on the weekends and that Mondays best suited his agenda. As compensation for having to meet on Mondays, he offered to shorten the duration of this FFS-cycle from fifteen to ten weeks, since the learning plots had been planted five weeks earlier. As a result, the FFS skipped three of the five stages of the FFS methodology: 1) establishment of the group, 2) determination of the technical content and 3) establishment of the learning plots. The curriculum of this FFS became limited to the remaining two stages: implementation of the learning activities and graduation.

Case 3: Impositions of a distant supervisor

Luis (not his real name) was an extension-researcher for the national agricultural research service. As the head of the provincial field office, he led numerous projects, many of which relied on FFSs for capacity building. Luis was "a champion of FFS by-the-book". He expressed concerns over the "erosion" of the methodology. He observed that facilitators commonly cut corners at the cost of participants' learning. He emphasised that an FFS was not an FFS if it did not include the cornerstones of the methodology: AESA, learning plots, insect collections, and farmer-led experiments. He lobbied for the creation of a standardised test to ensure that facilitators and graduates met minimum standards of both the technical aspects of IPM and the learning process aspects of FFS.

Luis actively resisted collaboration between his organisation and the pesticide industry, as a result of what he understood as the inherent contradiction between a company's interest in selling products and the government's mandate to protect the public interest. Nevertheless, when he left for two years of graduate studies, his supervisor in the capital, who did not share his perspective, took advantage of his absence to establish a lucrative project with the pesticide industry. In Luis' absence, new approach to FFS underwent a strong transformation. When he returned in 2004, Luis' supervisor forced him to implement a "hybrid" FFS, a form that shared little in common with the original methodology. The new approach involved five modules that centred on getting farmers to adopt an "IPM technology package". Under the new designs, content became pre-determined, and there was little time for learning plots, AESA and experiments. Despite Luis' conviction for FFS by-the-book, externally imposed constraints compelled him to implement a very different form of the methodology.

What lessons do these experiences hold?

Despite much enthusiasm over early results, eight years later we observed that professionals and their institutions apply the FFS approach in diverse and even contradictory ways. Certainly, this approach is still applied in Carchi and elsewhere, but we have become concerned about what we see as a trend: the systematic translation of FFS (and FFS-like methodologies) from people-centred to more conventional technology-centred designs.

The FFS methodology requires space for open-ended, participant-led learning, integration of different types of knowledge (of both local and other experts), and flexible agendas. As the three cases have illustrated, in practice, professionals and their organisations commonly transform the FFS approach, providing different forms and meaning to it. Table 1 summarises the extremes that were observed in Carchi – what we call "FFS by design" and "FFS in the social wild". Due to its present conflicts with established ways of organising and conducting development practice, FFS by design requires protected space.

Conclusion

The strength of the FFS approach is that farmers –and not organisations, donors or vendors– determine the learning outcomes, and thus its development. Sadly, as an FFS Master Trainer in Ecuador confided: "As soon as the FFS-methodology was adopted by Ecuadorian institutions, it was pulled back into the paradigm it was supposed to challenge. Supporting farmers in local innovations became technology transfer again, and the farmer-led, demand-driven character was replaced by externally-driven development."

Farmer-led methodologies demand a very distinct way of working that conflicts with conventional development practice. If we believe that FFS is the right way to go, then we need to provide attention to the professional and organisational conditions that determine who is in the "driver's seat" of development. Until more conducive conditions for people-centred development are established, as we have seen in Ecuador, approaches such as FFS will continue to scale up in name but not in meaning.

Recently, awareness over the erosion of locally-led development has led partners in Ecuador and elsewhere in the Andes to re-organise. In April 2007 the different agroecology networks in Ecuador met to discuss ways of protecting people-centred development at its national conference, leading to the creation of a new collective charged with advocacy. In October, the Network of Alternative Agriculture and Action (RAAA) in Peru organised a national seminar on agrarian development that emphasised changes needed for enabling more locally-led development, placing the agenda of the National Association of Ecological Producers (ANPE) at centre stage. The emerging Program for Local Innovation in Sustainable Agriculture and Natural Resource Management in the Andes (PROLINNOVA-Andes) is organised around the concept of peoples' science and is establishing a network of like-minded actors in Bolivia, Peru, and Ecuador to create safe spaces for locally-led learning and innovation.

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Table 1. Divergent forms of applying FFS

	FFS "by design"	FFS in the "social wild"
Goals and didactics	Challenge conventional practices through open-ended, farmer-led innovations and experiments. Based on discovery-based-learning an learning-by-doing	Transfer of knowledge and technology, diffusion of IPM-packages through learning
Learning process	Open-ended	Project-based
Decision making	Based on analyses and discussion	Based on assumption, generalisations and routines
Facilitation	Participative, enthusiastic, working with the farmers	Steering, demonstrative and lecturing
Agenda setting/ ownership	Organised around the life cycle of a crop or animal. The FFS-participants determine crop, curriculum and experiments, are actively involved, experience ownership and responsibility over their learning process and activities	Organised within the boundaries of organisational and donor preferences. The FFS-participants are passively involved, facilitators determine and own the learning process and activities
Long term objectives	Nurture groups that will continue to address agricultural and community problems on their own and with technical backstopping: 'Farmers as the subject of development'	Increase food production: 'Farmer's attitudes, lack of knowledge, and practices are an object/constraint of a development process'

Ecofriendly practices assist in controlling coconut mite

A. Vakeesan and G. Mikunthan

Coconut, *Cocos nucifera* (Arecaceae) is one of the most valuable perennial crops of the humid tropics. In Sri Lanka, it is grown in the coastal regions, and is seen as one of the key plantation crops because it contributes to the country's economy and is a main part of the daily diet of the average Sri Lankan, providing 25 percent of the daily calorie intake.

The coconut mite (CM), *Aceria guerreronis*, has emerged as a main coconut pest after being introduced to the island in late 1997. The sudden outbreak of this pest in coconut plantations threatened the copra industry in Sri Lanka, reducing yields and economic returns. This has drawn the attention of researchers, traders and the farming community as it threatens the livelihoods of millions. CM control is not yet successful for many reasons. Coconut is a tall tree, and manipulation of this ecosystem is extremely difficult. Studying pest occurrence and treatments is very difficult. CM completes its life cycle within 8 - 15 days, and thrives in the favourable conditions on the island throughout the year, spreading mainly by wind. Various chemical control measures have been recommended, but most of them are unsuitable, as they do not control the tiny mites successfully, are extremely poisonous, and carry the risk of eliminating parasites and predators of mites rather than controlling CM.

Hence a need has arisen to look for alternative control measures. A study was undertaken by the Department of Agricultural Biology of the University of Jaffna, trying to find suitable but eco-friendly measures to manage the CM in the coconut plantations of the Jaffna peninsula. Three thousand palms were assessed, measuring the surface nut damage, from August to December 2005, in different locations in the north of the country to detect mite tolerant varieties. Recommendations were made to coconut farmers based on the assessment and experiences.

Shape and colour of the nuts

It was found that the shape and colour of the nuts determine their susceptibility to CM attack. In the northern part of Sri Lanka, coconuts were round or oval, and the round shaped nuts were completely free from CM attack. It is thought that it is mechanically impossible for the mites to get under the floral parts, which sit very tightly on the nut. The tightness may be affected by the vigour or condition of the plant.

In Jaffna, 'dwarf green', 'dwarf brown' and 'king' coconut types are commonly grown. These cultivars may be grouped according to the colour of the nut. Assessment was done by quantifying the scarring of the nut surface. Among the cultivars, the dark green had the least mite damage. This might be due to the presence of wax on the surface of nuts. It is believed that

Photo: A. Vakeesan

Managing CM in coconut-based ecosystems presents a variety of challenges.

the cultivars have different amounts of wax on the nut surfaces. This may restrict the mite finding and settling on the nut. Hence, recommendations have been made that round shaped and dark green are the twin agronomic aspects of the coconut that help to guard against the CM attacks.

Keeping the brown

K. Rajukkannu, P. Ramadass and J. Jecitha

Mr. Manickavasagam is an organic farmer living in North Poigainallur, a coastal village in Nagapattinam, in the state of Tamil Nadu. His farm escaped unaffected while his neighbours' fields suffered total crop losses as a result of the attack of the brown plant hopper (*Nilaparvata lugens*, or BPH) in 2005.

For several years, Mr. Manickavasagam has been interested in organic farming. In 2005, with the assistance of Kudumban, a local NGO, he tried following the System of Rice Intensification (SRI) method. He transplanted his seedlings in October 2005, paying special attention to the spacing between them. He added four tons of farmyard manure to his 0.78 acre field, and 150 kg of azolla was applied 15 days after transplantation. He also sprayed *panchakavya* and *amirtha karaisal*, two organic inputs traditionally used in this area, prepared by fermenting cow urine, ghee and curd. These inputs proved their value by providing strength and greater resistance to the crop. This was clear after the heavy rains and floods of December 2005. In addition, everyone in the village witnessed with curiosity and surprise how all adjacent fields became severely affected by the brown plant hopper, while they were hardly visible in the SRI plot.

Mr. Manickavasagam decided to document the differences between his and his neighbours' fields, receiving the help of the farmers participating in Kudumbam's training courses. The first

Cropping System

The Coconut Cultivation Board in Jaffna is trying hard to extend coconut cultivation, and regularly provides farmers with advice. However there are few extension workers for coconut, and most farmers in Jaffna lack access to information, especially for mite control. Intercropping with the multipurpose leguminous tree, *Gliricidia sepium* is recommended by the Coconut Research Institute (CRI) and is well practised by the farmers. Intercropping of pineapple has also been successful in the western part of the Jaffna peninsula. Mixed cropping systems, as well as those with good ground sanitation, showed low mite infestations, except for mixed coconut gardens with banana, which recorded the highest mite infestation. Banana uses large amounts of potassium, the lack of which in coconut may affect its water retention capacity. Mixing banana with coconut is therefore not advised.

Many coconut gardens are poorly maintained. Improper nutritional management may also cause increased mite attack. Moisture stress slows the growth of the nuts, which is thought to cause looser attachment of the nut to the floral parts, allowing space for the mites to enter and multiply quickly. In the urban areas of the northern region of Sri Lanka, especially in Jaffna, coconuts are cultivated around wells. After bathing, the water flows from the drainage channel and is used for irrigation. Better nutrient management is also practised by adding kitchen wastes, organic materials and fallen coconut leaves as compost manure. A half-circle trench is dug one metre away from the base of the tree, is filled with these organic plant wastes and covered. In the next season the other half of the circle will be filled and covered. CM attack has been reduced with this practice.

One farmer has successfully managed coconut mite using smoke. Fallen coconut leaves were burnt beneath the dwarf palms together with cuttings and leaves from neem bushes. Thick white smoke rises towards the bunches of coconuts. This practice gave an encouraging result, with a much lower CM incidence over three months. It is thought that the neem smoke and the substances left on the bunches repel coconut mites.

Conclusions

It is still too early and difficult to say whether CM can be controlled by natural agents in the field. We should, however, consider the agronomic aspects of the nut when recommending how to control CM. By developing varieties with favourable characteristics (i.e. round shaped and dark green nuts), crop breeding may help, but this is a long term and probably only partial solution to the pest.

General recommendations can be made that by maintaining a healthy coconut farm, following good management practices like irrigation, smoking with neem, regular compost application, and selecting suitable varieties, pest incidence can be reduced.

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plant hopper at bay with SRI


Photo: Authors

Wide spacings in SRI contribute to pest management and healthy crops.

observation referred to the spacing between seedlings: planted at 10 x 15 cm distances, there was no space between rows or hills when the conventional crop reached its maximum tillering phase. Furthermore, the liberal application of urea favoured a lush vegetative growth. This not only encouraged the incidence of the brown plant hopper, but it also contributed to the crop's lodging after the heavy rains. Concerned with the attack of BPH, and following the advice of a pesticide dealer, Mr. Manickavasagam's neighbours sprayed a synthetic pyrethroid, to no avail.

There were also clear differences in the populations of the natural enemies of BPH and other pests recorded in the SRI plot and in the conventional farms. While the first one reported spiders, myrid bugs, beetles and wasps, the conventional farms were devoid of natural enemies. The wider spacing adopted during transplantation (22.5 cm x 22.5 cm) and the consequent free air movement between two hills and rows, even after the maximum tillering phase, together with the presence of natural enemies, helped the plants resist the invasion and multiplication of BPH. Furthermore, the use of organic inputs such as azolla, *panchakavya* and *amirtha karaisal* clearly meant the plants could offer greater resistance.

All village farmers were surprised to see the extraordinary tolerance of the SRI rice plants, while the rice grown all around it succumbed to the pest. While the conventional farmers could not harvest a single grain from their fields, the organic farmer, despite his field being flooded by the rains, harvested an equivalent of 3000 kg/ha. This made the farmers of North Poigainallur clearly aware of the advantages of SRI and of organic farming when facing a severe pest incidence and unfavourable weather conditions. During the 2006-2007 season, naturally, more than 20 conventional farmers decided to try a different approach.

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Photo: Author

The potato experimental plot with many different potential breeds. While most died as a result of disease, some plants survived and produced high yields.

Multiple strategies on an organic farm in the Netherlands

Hans Peter Reinders

Niek Vos' organic farm is located in the centre of the Netherlands, on land which was reclaimed from the sea nearly 60 years ago. This area is now known as the North East Polder, and as it is below sea level, the polder is surrounded by enormous dikes that protect it from flooding. The land reclamation programme of the 1940s was designed to increase food production in the Netherlands, so the area was planned for agricultural development. Sixty years later, this area has very fertile clay soils, and excellent characteristics for growing seed potatoes.

Niek Vos' farm is certified organic, and in many ways represents the market oriented organic production systems which can currently be found in the Netherlands and western Europe. Among other things, these systems are based on the use of organic manures, while at the same time avoiding the use of chemical inputs like fertilizers and pesticides. Products are sold with a special label allocated by the certifier, and generally get a better price in the markets. A large percentage of every year's production is exported to Germany, Scandinavia and the U.K., and sold in these countries' organic markets.

Niek manages his farm alone. Labour is very expensive in the Netherlands, but high-tech machinery is available. These two factors mean that everything that can be mechanised is done by machines, as this is the most economic option. Each farmer owns some machines himself, while other very specific and expensive machines can be rented from specialised enterprises. Still, not all work can be done by machines, so during the busy months, just after planting, additional labour has to be contracted (in particular for weed control). These are often schoolboys who want to make some money after their classes. Occasionally, labour is also contracted during the harvest.

Many simultaneous strategies

In Europe, as anywhere else, the climate determines the crops you can grow, but also determines what kind of pests and diseases you can expect. In the Netherlands, the wet, relatively cool and temperate conditions mean that insects are not that difficult to handle. However, this climate provides the best conditions for the development of fungi. As on many other farms, the fungus diseases which attack many of the crops grown on Niek Vos' farm are hard to control.

Niek Vos' farm has been organic since 1986. Over the last 20 years he has learned how to deal with the major pests and diseases and has found out that ecological pest management is, like weed control, an enormous challenge. The strategies he currently uses to avoid crop loss on his farm are the result of these 20 years of experience: good crop rotation, interaction with the season at the right moment; the design of the farm; cultivation measures and the use of resistant or tolerant varieties.

Crop rotation
Good pest and disease management is based in a well-designed crop rotation system. This is why Niek Vos grows more than 8 different crops in one year, and he does not sow the same crop for at least 6 years in the same field. He grows potatoes, alfalfa, maize, beetroot, wheat, onions, carrots and oats. A lot of diseases are avoided when these crops are not grown on the same plot for a relatively long period of time. Rotating crops and adding a fallow year to the cycle (when nothing is grown), results in potato crops which are free of nematodes (*Globodera* spp.) and rhizoctonia (*Rhizoctonia solani*). Long sowing intervals also prevents carrot leaf spot (*Alternaria dauci*) and wheat head blight (*Fusarium graminearum).* Nevertheless, because many different species are grown, this crop rotation has a large impact on farm income. Not all crops are equally profitable as some have a lower price in the market. But good rotation requires diversity, so it is necessary to grow the less profitable crops as well.

Interaction with the season
Several pests and diseases can be avoided by sowing at the right moment. Crop loss can be avoided if a crop is sown when its pest is not present. Carrot rust fly (*Psila rosae*), for example, can cause severe damage to carrot fields. As part of their reproduction cycle, the adult flies out twice a year, always in the same month, and this is when they infect the carrots. By sowing his carrots at the beginning of June, after these flights have already taken place, Niek Vos makes sure that the insects will not affect his crop. Similarly, the presence of spores of *Phytophthora infestans*, the late blight fungus, increases tremendously during the growing season. Niek and his neighbours know that it is important to plant and to harvest potatoes as early in the season as possible. A good strategy to do this is by pre-germinating the seed potatoes. The time of planting should be balanced with the risk of frost damage early in the year.

Design of the farm
In Niek Vos' opinion, a well-designed farm is open. In an open farm, the wind is able to blow through the crops where different insects look for shelter, blowing them away before they are able to affect the crops. At the same time, the wind can contribute by "drying" the field, so the optimal conditions for the fungus diseases are reduced.

Detailed observation has also inspired many new ideas for the farmers in the North East Polder. A good way of avoiding rodent damage in beetroot, for example, is the construction of nest boxes for predatory birds like falcons. When the boxes are used for nesting, these birds catch an enormous amount of mice to feed their young birds.

Agronomic aspects
Experience has also shown that there is a close relationship between some common agronomic practices and the presence of pests and diseases. One of them is the quantity of manure used per hectare. The availability of nitrogen, in particular, will make a plant grow fast, directly influencing the way the crop develops. Such growth stimulates productivity, but also has a negative impact, as it increases a crop's susceptibility to fungus. Good leaf development will mean that a crop will not dry easily, and the crop will be affected by fungus-borne diseases rapidly. The fields where more susceptible crops are grown should therefore receive a limited amount of manure before sowing.

Some crops suffer from bird attack. Pigeons or crows dig up the recently sown seeds and eat them. It is thus necessary to sow the seeds a little deeper than usual, making sure that they are out of reach, but that at the same time they can germinate easily.

Resistant or tolerant varieties
Lastly, an important strategy in pest and disease management is the use of resistant or tolerant varieties. The choice of varieties depends on several factors and is always a compromise between different characteristics. A more disease-tolerant variety can be less productive or have characteristics which the consumer does not like, like taste, colour or shape. Niek Vos gives priority to varieties with high resistance to pests and diseases, even if, as a consequence, he has lower yields per hectare. In this way, he has been able to avoid leaf rust (*Puccinia* spp.) in his cereals (oats and wheat) and to reduce the damage caused by cercospora (*Cercospora beticola*) in his beets. Throughout the years, he has also seen that the attack of downy mildew (*Peronospora destructor*) on onions, and late blight in potatoes can be reduced by growing more tolerant varieties, even if it is impossible to avoid the diseases totally.

How are new strategies developed?

Finding new strategies to control pests and diseases is an interesting process that has changed over the years. In the beginning, when he started farming organically, Niek and his neighbours didn't know how to control pests efficiently. They needed to find alternatives in a dynamic way, trying out different strategies for different crops and being open to change. Small changes in the day-to-day management of the farm resulted in new ideas emerging, many of which became effective new strategies. Exchanging information with colleagues was fundamental. A good example of this is how Niek found out how to grow carrots without relying on chemical pesticides, when none of his neighbours knew how to do it.

Several years ago, Niek rented part of his shed to a trader, an old man from another region, as he was not going to use the space for his own harvest and some additional income is always welcome. The trader used Niek's shed to store carrots. This man had worked with carrots for more than 50 years, and he had seen how people used to grow them in the past, before pesticides were introduced. The old trader recommended an even longer crop rotation than the seven year cycle which organic farmers were familiar with. So Niek decided to make an exception to his regular seven year rotation scheme, changing it to 14 years. Of course it took a very long time to see the results of the experiment and check whether the old trader was correct. Eventually, he was proved right. Having met the old trader by chance, and being open to changes, Niek could now grow carrots organically without problems. Knowing how important it is to exchange information with colleagues, Niek Vos has always been an active member of a farmer's organisation (see *LEISA Magazine* Vol. 23 no.1). The exchange of information about pests and diseases is always an important topic at the meetings: the 14 year cycle for carrots was quickly followed by other farmers.

A personal breeding programme to avoid late blight

The incidence of late blight in potatoes in the Netherlands has grown dramatically in recent years. The economic profitability of the tuber crop was so high that conventional cultivation became very intensive. This intensive production meant that late blight increased as well. Spraying fungicides helped control this disease in conventional farms, but for organic growers, cultivating


Photo: Author

Phytophthora is a problem in Dutch agriculture, more so in organic farms where alternatives to pesticides need to be developed.

potatoes became nearly impossible. Varieties highly resistant to late blight were all but non-existent. It is not commercially attractive for Dutch breeding companies to develop resistant or tolerant varieties. The market for organic seed potatoes is very small, while at the same time there is a high demand for nematode resistant breeds (a characteristic which is not so relevant for organic growers as nematodes are avoided by crop rotation).

Niek Vos decided to start his own breeding programme and develop a variety which would tolerate the presence of *Phytophthora*. Thanks to a verbal agreement with a local seed company, he received 8000 clones of different potential breeds every growing season, together with the results already found by the company. Over many seasons, when the fungus started affecting the crop, he selected all the infected clones and threw them away. At the end, only a few clones remained, showing some resistance against late blight. Some years not even 10 potential breeds survived. These clones were tried again during the following season, and those which survived again were then checked according to other characteristics (such as shape, taste, productivity, frying qualities, and resistance to other diseases). Resistant clones were found several times, but often they had other unattractive characteristics, which made it impossible to bring them out as a new commercial breed on the market. As Niek found out, it is hard to breed a variety that resists a disease, and which has all the characteristics which consumers demand as well as all the characteristics the crop needs to grow well. Tolerance or resistance to *Phytophthora* needs to be combined with more than 30 other important traits.

After more than 12 years, Niek is now happy to show some results (acknowledging that 12 years is a relatively short period for a crop breeding programme). One new clone resists the late blight without any significant yield loss, and it also has all of the other good qualities. This new clone is called “Bionica” and Niek Vos is the proud creator. Some tests have been done by the seed company recently, in order to register it as a recognised new breed, and soon it will be sold commercially. Niek’s neighbouring farmers are particularly interested in it, as are other organic producers in the Netherlands. And Niek plans to continue trying new clones, recognising that the struggle against the potato diseases needs to continue. Because of large-scale cultivation of potatoes, the *Phytophthora* fungus adapts rapidly, with new types developing fast. Resistant potato varieties therefore need to continue being bred.

This experience is interesting, in particular as it shows that management practices for dealing with pests and diseases are universal. Similar techniques are applied by LEISA farmers all around the world. The example of farmer Niek Vos also shows the enormous importance of sufficient availability of genetic resources and the need to protect genetic diversity of arable crops worldwide. Genetic diversity makes it possible to develop resistant varieties, and that is often the only way to avoid pests and diseases without using agro-chemicals.

■

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Call for articles

Living soils

June 2008, Vol. 24.2

Decreasing soil fertility is one of the world’s major agricultural problems. All over the globe, farmers are complaining that their soils are “tired” or “worn out”, and that their yields are falling. Reversing this trend, however, cannot be achieved by just adding fertilizers: healthy plant growth is dependent on the state of the soil that supports it (and therefore the importance of “feeding the soil, not the crops”). More than just looking at its chemical composition, this also means considering the existing soil micro-organisms and how the soil is able to sustain life. Enhancing soil fertility thus means creating favourable conditions for soil life, ensuring a good balance of components (air, water), and aiming at an optimal structure and texture.

Restoring and maintaining soil life is possible through various means. This includes different agronomic techniques, such as using diverse cropping systems and sequences, adding mulch, opting for zero tillage or recycling farm resources. All efforts made towards improving the organic matter content in the soil help in making it productive and sustainable. At the same time, we need to consider that soil is also a community resource. This issue will therefore also highlight traditional practices for restoring soil health, the social agreements towards the prevention of soil deterioration, land tenure arrangements, and the cultural practices which have enabled improving and maintaining soils as a basis of farmers’ livelihoods.

Deadline for submission of articles: 3rd March 2008.

Social inclusion

September 2008, Vol. 24.3

Deadline for submission of articles: 2nd June 2008.

The advantages of *suve* farming

Patrick Mwalukisa

The round potato is commonly grown in the southern highlands of Tanzania, particularly in Makete District, and is regarded as a staple food for the *kinga* tribe. Makete is a small district in the Iringa region, characterised by two distinctive zones: the cooler wetter highlands, and the dryer warmer lowlands.

Agriculture in Makete

Agriculture is the mainstay of Makete's economy, and is mostly subsistence farming. Cash crops grown include pyrethrum and coffee, and food crops are maize, wheat, round potatoes, sweet potatoes, millet, sorghum, barley and different types of fruits. Cattle, goats, sheep, chickens and pigs are also kept, and some farmers are involved in tree planting for timber. Potatoes were promoted as a monocrop during the early 1970s when the government emphasised "modern" agriculture, with the practice of growing only one crop on a piece of land as a key idea. However, this practice has led to declining soil fertility and high infestation of disease and pests, which in turn has brought declining potato yields, less produce and increased poverty.

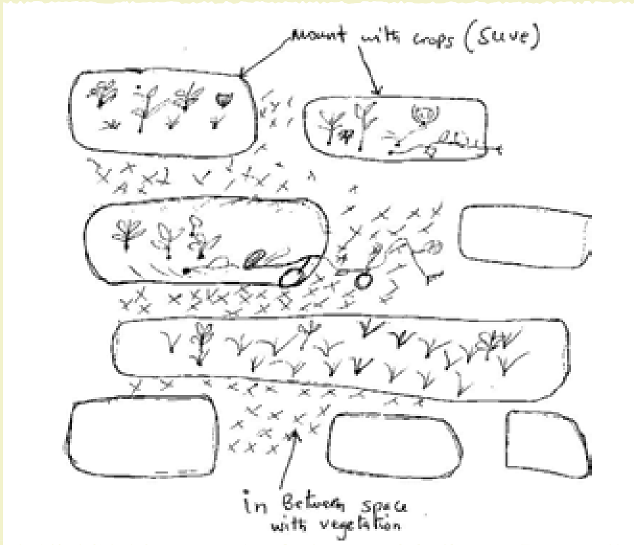
The main pests attacking potatoes in this area are the red bird beetle, cutworms and *fuko* (an underground rodent-like animal). The main diseases are blight and bacterial wilt. Potato is a heavy feeder crop as it requires a high amount of nutrients from the soil.

Suve farming system

Alternative solutions to such pest and disease problems have been developed by the small holder farmers with very limited support from the government or NGOs. As agro-chemicals are not common, farmers have had to be creative in solving their problems, discussing ideas and innovations. They have been practising various methods, such as the *suve* farming system.

Methods used by farmers to try and solve pest and disease problems include fallowing the plots, mixed cropping, breaking direct contact by leaving a bare area in between plots, soil sterilization, control of nutrient loss and improvement of soil structure. For example, plots of land are left fallow for two to three years to allow natural vegetation to regenerate. After this time, farmers clear the fallowed land. The cleared vegetation is collected and piled into mounds (or heaps), which are then placed on slopes in such a way that they block direct water runoff, reducing the speed of runoff and hence soil erosion. Farmers then scrape the soil surface between the mounds, and put all the materials (soil and weeds) on the mounds, where they are left to dry for one to two weeks before they are burnt. The mounds are again left to cool for another week before planting the seeds. One mound is planted with a number of crops, including cabbage, maize, finger millet, potatoes, pumpkins, or beans. The combination of these practices is known as the *suve* farming system.

This kind of farming requires an area with low population density, allowing farmers to rotate their farms each season. In Makete District, *suve* farms are often located far from homesteads, so much time is spent for travelling to and from home.



Advantages of *suve* farming practices

Suve farming is usually practised on sloping land. In some cases, farmers who have flat land also prepare *suve,* and plant other crops such as maize, beans and green peas between the mounds. The various practices involved in *suve* have many advantages. For example, fallowing interrupts the life cycle of plant diseases and pests associated with a specific crop, which helps to reduce crop losses. Planting mixed crops within the *suve* also reduces crop losses. Similarly, one mound is planted with different crops, which have different nutrient requirements and depths of nutrient uptake. The space between mounds tends to regrow very fast, even before the onset of the rainy season, which controls soil erosion. Because of the distance between one mound and another, the spread of pests and diseases is reduced due to the vegetation barrier. Soil fertility is improved by adding ashes and planting legumes, which also improves soil texture for easy water penetration and tuber enlargement.

The need to improve *suve* farming

The *suve* farming practice is an innovation by the smallholder farmers in Makete district. The need to improve the *suve* is inevitable, however, because the way crops are planted makes it difficult to harvest earlier maturing crops such as potatoes. For example, when planting finger millet and potatoes together, one might uproot the finger millet while harvesting the potatoes. The distances between *suve* is extremely big, and may require some modification, so that other crops can be grown.

This practice is very well adopted in hilly areas in Makete District and gives good results. Nevertheless, it would be useful to carry out some studies to substantiate the good results observed, and seek further improvements.

■

Patrick Mwalukisa, Agriculture Officer; Head of Agriculture Department, Ileje Rural Development Organisation (IRDO). P.O. Box 160, Ileje, Mbeya, Tanzania.

Guidelines: Integrated Pest Management

AMEF, 2006. Guidelines No. 3. AME Foundation, P.O. Box 7836, Bangalore 560 078, India. E-mail: amebang@giasbg01.vsnl.net.in ; http://www.amefound.org

This paper provides, in easy to understand English, the guidelines that have been developed to assess the IPM activities taken up by the farmers in the AME-IPM programme. The focus of this programme is on growing a healthy crop using low external inputs and non-chemical alternatives.

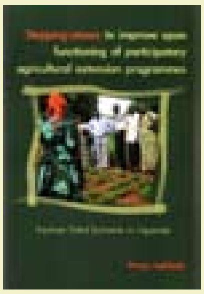
Manage insects on your farm: a guide to ecological strategies

by Miguel A. Altieri, Clara Nicholls and M.A. Fritz, 2005. ISBN 1-888626-10-0. Sustainable Agriculture Network (SAN), P.O. Box 753, Waldorf, Maryland 20604-753, U.S.A. E-mail: san_assoc@sare.org ; http://www.sare.org/publications

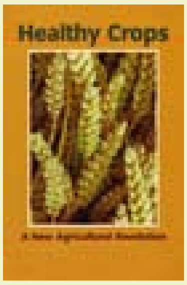
While every farming system is unique, the principles of ecological pest management apply universally. "Manage Insects on Your Farm" highlights the ecological strategies that improve a farm's natural defences and encourage beneficial insects to attack pests. This book presents how ecologically based pest management works, showing the strategies used by farmers around the world to address insect problems. As part of the principles of ecologically based pest management, it describes how to manage soils to minimise the presence of pests, and describes the most common "beneficial agents" on a farm.

Stepping-stones to improve upon functioning of participatory agricultural extension programmes: Farmer Field Schools in Uganda

by Prossy Isubikalu, 2007. ISBN 978-90-8686-021-0. Wageningen Academic Publishers, P.O. Box 220, 6700 AE Wageningen, the Netherlands. E-mail: sales@wageningenacademic.com



The Farmer Field School (FFS) approach has been promoted as a tool for participatory learning and experimentation all over the world. This book, the author's doctoral dissertation, is a critical analysis of the introduction of the FFS concept into the agricultural innovation system in Uganda. This detailed study of institutional factors, from the level of international donor organisations down to local leadership and gender relations, together with the analysis of technical factors in different rural areas of Uganda, makes clear that an FFS is more than a local tool for farmer participation in agricultural improvement. Isubikalu shows that the implementation of the FFS concept in Uganda has failed to increase the responsiveness to local problems. She provides stepping stones for redesigning FFS to fit the specific conditions in Uganda and perhaps elsewhere in Africa.



Healthy crops: A new agricultural revolution

by Francis Chaboussou, 2004. ISBN 1-897766-89-0. Jon Carpenter Publishing, Alder House, Market Street, Charlbury, OX7 3PQ, U.K.

Based on his own research and that of others, Francis Chaboussou argues for improving the health of crops as an alternative to the use of chemicals when trying to eliminate pests and diseases. Healthy crops resist attack, but chemical pesticides and fertilizers weaken plants, making them vulnerable to disease. Learning about, and treating the sick rather than the sickness, is an effective tool for plant protection that can substantially reduce problems, especially for those working towards an agriculture without chemicals.

A guide for conducting Farmer Field Schools on cocoa integrated crop and pest management

by Soniia David et al., 2006. International Institute of Tropical Agriculture (IITA), Sustainable Tree Crops Program. P.O. Box 135, Accra, Ghana. E-mail: stcp-wca@cgiar.org ; http://www.treecrops.org

The Farmer Field School (FFS) approach is relatively new to West Africa, and there are few examples of its application to tree crops and perennial crops. Since 2003, the Sustainable Tree Crop Program (STCP) has pioneered FFS on cocoa integrated crop and pest management in Cote d'Ivoire, Ghana, Nigeria and Cameroon. Although it is based on the experience built with cocoa FFSs, many of the principles and recommendations can be applied to FFSs on other tree crops. The manual is directed at FFS programme managers and other development practitioners.

Controlling crop pests and diseases

by Rosalyn Rappaport, 2004. ISBN 978-1-85339-600-7. Practical Action Publishing, Rugby, Warwickshire, CV23 9QZ, U.K. E-mail: publishinginfo@practicalaction.org.uk

This book was designed for extension staff, and as such it is clearly written and very practical. It gives a basic understanding of pests, diseases and how to control them. It is presented as an illustrated extension course, using strip cartoons and visuals, to provide extension workers examples of how they can easily communicate with farmers on a very complex and technical subject. The book includes information on integrated pest management, protecting crops from larger animals and wind, and presents local alternatives to pesticides and insecticides.

Handbook of sustainable weed management

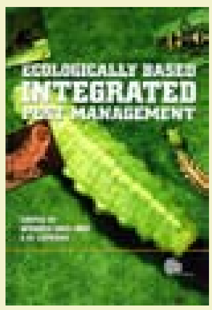
by Harminder Pal Singh, Daizy Rani Batish and Ravinder Kumar Kohli (eds.), 2006. ISBN 978-1-56022-957-5. Food Products Press / Haworth Press, 10 Alice St., Binghamton, New York 13904, U.S.A. E-mail: getinfo@haworthpress.com

This manual presents many economically and environmentally friendly methods of managing weeds. Its 25 chapters cover a wide range of topics, from weed suppression by cover crops, crop rotation and reduced tillage to integrated management of pasture weeds. This book is meant for students, teachers, researchers and practitioners. The focus is on designing weed management strategies that reduce the use of herbicides, restore ecological balance, and increase food production.

Ecologically based integrated pest management

by Opender Koul and Gerrit W. Cuperus (eds.), 2007. ISBN 978-1-84593-064-6. CABI, Nosworthy Way, Wallingford, Oxfordshire, OX10 8DE, U.K. E-mail: orders@cabi.org ; http://www.cabi.org

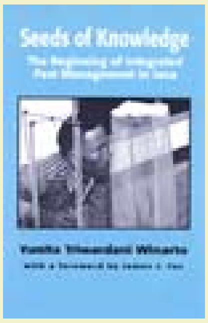
Integrated pest management (IPM) is a sustainable approach to manage pests through biological, cultural, physical and chemical means. Comprehensive IPM programmes require an understanding of the ecological relationships between crops, pests, natural enemies and the environment. This book reviews several cases in which ecologically-based IPM was used, and analyses the effectiveness of numerous methods, from the ecological effects of chemical control practices to the ecology of predator-prey and parasitoid-host systems. This study book is meant for teachers, researchers and students involved in entomology, crop protection and pest management.



Push-Pull curriculum for Farmer Field Schools by Z.R. Khan, D.M. Amudavi, C. Midega, J. Pittchar, D. Nyagol, G. Genga, A. Ndiege, P. Akelo, J.A. Pickett, L.J. Wadhams, F. Muyekho and B. Nyateng, 2007. ISBN 92-9064-188-6. International Centre of Insect Physiology and Ecology, Nairobi, Kenya. E-mail: icipe@icipe.org ; http://www.infobridge.org/ffsnet/output_view.asp?outputID=3835
This easy-to-read Push-Pull curriculum shows how farmers can manage two of the major pests of maize: stemborers and striga weed. The Push-Pull strategy is a novel system of intercropping designed to manage the agro-ecohabitat for achieving higher maize yields, while at the same time providing fodder, enriching the soil and conserving biodiversity. Push-Pull can also be applied in the production of sorghum and millet, being an affordable, appropriate and socially acceptable technology for many small scale farmers.

Community integrated pest management in Indonesia: Institutionalising participation and people centred approaches by Mansour Fakih, Toto Rahardjo and Michel Pimbert, 2003. ISBN 1-84369-485-9. International Institute for Environment and Development (IIED), Institute for Development Studies (IDS), and Research, Education and Dialogue (REaD). IIED, 3 Endsleigh Street, London WC1H 0DD, U.K. E-mail: info@iied.org
This study assesses the extent to which community IPM has been institutionalised in Java (Indonesia). Participatory research methods were used by multidisciplinary and interorganisational teams of researchers to analyse policies, organisations and impacts. The aim of the inquiry was not only to conduct research, but also to bring about political change and the empowerment of those involved.

Seeds of knowledge: The beginning of integrated pest management in Java by Yunita Triwardani Winarto, 2004. ISBN 0-938692-81-X. Monograph 53, Yale University Southeast Asia Studies, P.O. Box 208206, New Haven, Connecticut 06520-8206, U.S.A. E-mail: seas@yale.edu ; http://www.yale.edu/seas/seedsofknowledge.htm

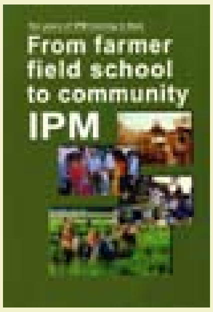


This book examines the process of knowledge construction among rice farmers, the cultivators of lowland irrigated rice fields on the north coast of West Java, Indonesia. It tells how these farmers received, developed, and then transmitted knowledge over a period of two years between the 1990 dry season, when they had experienced a severe outbreak of white rice stem borers, and the end of the 1991/92 rainy season. It is the story of how the introduction of integrated pest management principles led to changes in the farmers' knowledge of pests and diseases and, subsequently, to changes in their farming practices.

Natural crop protection in the tropics: Letting information come to life by Gabriele Stoll, 2005. ISBN 3-8236-1317-0. Margraf Verlag, Kanalstrasse 21, D-97990 Weikersheim, Germany. E-mail: info@margraf-verlag.de
The first edition of this book was published in 1986, and since then it has been revised, enlarged, updated and translated into many languages. It presents practical information on natural crop protection techniques. Recognising that these techniques, which derive from local, traditional and scientific sources, often have to be verified, adapted or improved, it includes a section on approaches and methodologies by presenting a number of case studies. Valuable suggestions are made for research to further improve engagement in developing natural crop protection practices for resource-poor and organic farmers.

New ways of developing agricultural technologies: The Zanzibar experience with participatory integrated pest management by Gerard C.A. Bruin and Frans Zeeman, 2001. ISBN 90-6754-624-0. Wageningen University and Research Centre / Technical Centre for Agricultural and Rural Cooperation (CTA). P.O. Box 380, 6700 AJ Wageningen, the Netherlands. E-mail: cta@cta.nl
The purpose of this publication is to provide insights into effective methods of crop protection and agricultural development in Africa. It links a case study in participatory integrated pest management (IPM) development in Zanzibar with current trends in development cooperation, agricultural and rural development. It describes the results in five different cropping systems, and general lessons are drawn from the successes and failures. Lessons include the necessary adaptations of the FFS model to the typical agro-ecological and socio-economic conditions of small-scale farmers in East Africa. The conclusions of this work show that FFSs can work in an East African context if certain conditions are met.

From Farmer Field School to community IPM: Ten years of IPM training in Asia by John Pontius, Russell Dilts and Andrew Bartlett, 2002. FAO Community IPM programme. FAO Regional Office for Asia and the Pacific, 39 Phra Athit Road, Bangkok 10200, Thailand. E-mail: elisabetta.tagliati@fao.org
This book presents a comprehensive account of IPM as a farmer-centred and local need-responsive approach, which was developed on the rice farms of southeast Asia. More than 2 million rice farmers in Asia have taken part in over 75 000 Farmer Field Schools between 1990 and 1999, boosting their yields and incomes, cutting down the use of chemicals and improving the ecological health of their fields. The publication includes step-by-step instructions on organising and running Farmer Field Schools, along with detailed case studies and personal experiences of farmers who benefited from the programme. A separate section outlines the IPM programme activities in Bangladesh, Cambodia, China, Indonesia, Nepal, Sri Lanka and Viet Nam.



Visit our website: http://www.leisa.info

Global Plant Clinic

http://www.globalplantclinic.org

The CABI Bioscience Global Plant Clinic provides a comprehensive diagnostic and advisory service for disease problems on all tropical crops. The website gives expert advice on the interpretation and application of diagnostic results drawing on the extensive international experience in a wide range of crops and information from CAB International's Crop Protection Compendium. This service is freely available for people in developing countries involved in agriculture.

Action Centre for the FAO Code of Conduct

http://www.fao-code-action.info

PAN Germany, Nernstweg 32, D-22765 Hamburg, Germany.

Set up by Pesticide Action Network (PAN) Germany in cooperation with the PAN regional centres, this website is a one-stop location for getting to know what the Code says about the responsibilities of governments, the pesticide industry, the food industry, farmers and public interest groups to prevent harm caused by pesticides. In addition you can easily identify what the Code says about important pesticide-related issues including pesticide use, pesticide advertising, pesticide labelling and distribution and also about alternatives to toxic pesticides. Support pages provide information on useful resources and suggestions for action.

Progressive pest management

http://georgeeks.googlepages.com/home

This website provides a collection of articles and policy papers in favour of a "progressive pest management", a concept first coined by the the Pesticides Trust (predecessor of Pesticide Action Network UK) in a policy document produced for the Commission of the European Communities.

EcoPort

http://www.ecoport.org

EcoPort is a single, contiguous, and communal website that enables individuals and institutions to pool their information. EcoPort is very similar to WikiPedia insofar as both EcoPort and WikiPedia come into existence, grow and are improved by individuals who put information into a communal database. EcoPort is the ecology portal. It is a database, designed and devoted entirely to the inter-disciplinary integration of information to manage biodiversity.

Pesticide Action Network Africa

http://www.pan-afrique.org

B.P. 15938 Dakar-Fann, Dakar, Senegal.
E-mail : panafrica@pan-afrique.org

Pesticide Action Network (PAN) is a network of more than 600 participating non-governmental organisations, institutions and individuals in over 90 countries, working to replace the use of hazardous pesticides with ecologically sound and socially just alternatives. Their general aim is to eliminate the use of hazardous pesticides, reduce overall use, risk and dependence of pesticides, and increase support for community-based control over a sustainable produced food supply. PAN has five independent, collaborating Regional Centres that implement its projects and campaigns. One of these, PAN Africa, publishes three issues per year of *Pesticides & Alternatives*, a newsletter on pesticide news, alternatives to chemicals, Integrated Pest Management and sustainable agriculture.

Pest Net

http://www.pestnet.org

PestNet is an e-mail network that helps people in the Pacific and South East Asia obtain rapid advice and information on plant protection. It links the Pacific and South East Asian regions with plant protection specialists worldwide and is free to members. The website provides a question and answer service but also provides the summaries of former questions, all ordered per crop and pest. This is an easily accessible and very valuable information resource.

Global Farmer Field School Network and Resource Centre (FFSnet)

http://farmerfieldschool.info

FFSnet Support Unit, Simon Vestdijkstraat 14, 6708 NW Wageningen, the Netherlands.
E-mail: arnoud.braun@farmerfieldschool.net

The objective of this FFS network is to support national and regional knowledge sharing, networking and co-ordination among partners for a more effective implementation of Farmer Field School interventions. Its aim is to serve as a decentralised network and resource centre to cater for strategies and mechanisms for institutionalisation and scaling-up, quality control mechanisms and low cost implementation strategies and mechanisms. The site provides access to a discussion forum. By providing access to a broad database it facilitates the exchange of experiences, giving quick access to resources and training materials.

Online information service for non-chemical pest control in the Tropics (OISAT)

http://www.oisat.org

PAN Germany, Nernstweg 32, D-22765 Hamburg, Germany.
E-mail: oisat@pan-germany.org

OISAT is an information management tool for non-chemical pest management in the tropics. There are two components: OISAT Info and OISAT Partner Network. OISAT Info provides easy to read web-based information on how to produce key crops using affordable preventive and curative non-chemical crop and pest management practices. The technical information is arranged by crop and by pest/disease or weed for easy reference. OISAT PartnerNetwork is a platform for information dissemination, information sharing/exchange, and the integration of the online information into training and extension services. This aims to ensure an effective and efficient information flow from web to field.

National Sustainable Agriculture Information Service

http://attra.org/pest.html

P.O. Box 3657, Fayetteville, Arkansas 72702, U.S.A.

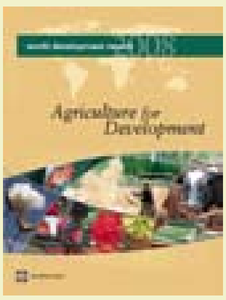
ATTRA, the National Sustainable Agriculture Information Service, provides information and other technical assistance to farmers, ranchers, extension agents, educators, and others involved in sustainable agriculture in the United States. It is managed by the National Center for Appropriate Technology (NCAT), a private nonprofit organization which operates projects to promote self-reliance (especially for low-income people) through wise use of appropriate technology. Its website provides a link to a new, on-line pest management tool: a database which highlights reduced risk materials that can be integrated with ecological pest management strategies. It also includes a series of publications as PDF and HTML files, as well as links to other North American websites.

Sustainable agriculture: A pathway out of poverty for India's rural poor Sustainet / GTZ, 2006. Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Postfach 5180, 65726 Eschborn, Germany. E-mail: info@gtz.de ; http://www.sustainet.org
Sustainet, the Sustainable Agriculture Information Network, aims to systematically evaluate, communicate and disseminate successful approaches and concepts of sustainable agriculture in selected pilot regions. This book is the output of an evaluation of "good agricultural practices" in 14 development projects in remote parts of India. The local partners were selected and their projects documented with a set of self-assessment guidelines. The book was prepared through an intensive, participatory workshop in which participants from the Sustainet partners wrote, presented and revised the various chapters. The book's three main parts cover organic agriculture, land and water management, and strategies to improve market access for small-scale farmers. Each part contains several cases, describing the project, its results and impacts, and drawing lessons from it that can be applied to projects elsewhere.

Sustainable agriculture: A pathway out of poverty for East Africa's rural poor: Examples from Kenya and Tanzania Sustainet / GTZ, 2006. Deutsche Gesellschaft für Technische Zusammenarbeit (GTZ), Postfach 5180, 65726 Eschborn, Germany. E-mail: info@gtz.de ; http://www.sustainet.org
This book is one of the results of a process similar to the one mentioned above. It presents nine examples from Kenya and Tanzania, covering a wide range of farming techniques, livestock raising, extension methods, marketing and networking approaches. All of them discuss the changes needed in the policy environment in order to foster sustainable agriculture.

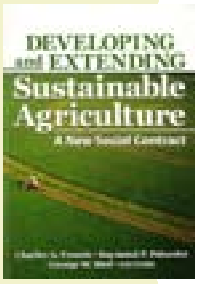
The global food economy: The battle for the future of farming by Tony Weis, 2007. ISBN 978-1-84277-795-4. Zed Books, 7 Cynthia Street, N1 9JF London, U.K. E-mail: enquiries@zedbooks.demon.co.uk ; http://www.zedbooks.co.uk
As the author points out, the main aim of this book is to examine in a concise and accessible way the major contemporary dynamics, problems and inequities of the global food economy. The current food economy is characterised by immense contradictions. Food mountains, bountiful supermarkets and rising levels of obesity stand in stark contrast to widespread hunger and malnutrition. This book looks at how such a system came about, and how it is being enforced by organisations such as the WTO. It also considers how we can find a way of building socially just, ecologically rational and humane food economies.

World Development Report 2008: Agriculture for development The World Bank, 2007. ISBN 978-0-8213-6807-7. The International Bank for Reconstruction and Development / World Bank, 1818 H Street NW, Washington DC 20433, U.S.A. E-mail: feedback@worldbank.org ; http://www.worldbank.org
The World Bank has recently released its World Development Report 2008, which calls for greater investment in agriculture in developing countries. It also warns that the agricultural sector must be placed at the centre of the development agenda to realise the goals of halving extreme hunger and poverty by 2015. Dealing mainly with the issue of agriculture and poverty reduction, the report examines what agriculture can do for development, and looks at the most effective instruments for using agriculture for development. The third part of this report looks at how to best implement agriculture-for-development agendas. The website profiling the World Development Report also includes policy briefs, special reports, and background papers on agriculture and environment, agriculture and climate change, biofuels, and agriculture and poverty reduction, among others. In addition, the site features a slideshow, as well as compilations of feature videos, press briefings and podcasts on the topic of agriculture and development.



Agricultural research at the crossroads: Revisited resource-poor farmers and the Millenium Development Goals
by Bo M.I. Bengtsson, 2007. ISBN 978-1-57808-514-9. Science Publishers, P.O. Box 699, Enfield, New Hampshire, 03748, U.S.A. E-mail: webmaster@scipub.net ; http:// www.scipub.net
This book describes and analyses agricultural technical changes over more than three decades for a group of resource-poor farmers in Ethiopia, Sweden and Trinidad and Tobago. By revisiting the same farmers in these countries the author has gained first-hand knowledge about progress and technical change in agriculture during the period between 1960 and 2000. This set of empirical data offers an interesting platform for the analysis of agricultural research and development in the context of globalisation, and of the ways in which global threats and challenges may affect future policy for actions to actually reach the poor. Finally, this leads to a discussion of research policy on future agriculture and land use.

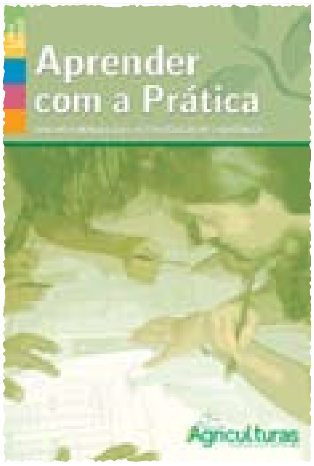
Learning endogenous development: Building on bio-cultural diversity
COMPAS, 2007. ISBN 978-185339-664-9. Practical Action Publishing, Rugby, Warwickshire, CV23 9QZ, U.K. E-mail: publishinginfo@practicalaction.org.uk
COMPAS is a network of development organisations that share a concern for endogenous development. Endogenous development focuses on working with local communities, through using people's own resources, strategies, and initiatives as the basis for their development. This book provides ideas, guidelines, and examples of how to put endogenous development into practice. It shows how field staff can be helped to learn, and how training or learning activities can best be organised, to support endogenous development.



Developing and extending sustainable agriculture: A new social contract
by Charles A. Francis, Raymond P. Poincelot and George W. Bird (eds.), 2006. ISBN 978-1-56022-332-4. Haworth Food & Agriculture Press, 10 Alice St., Binghamton, New York 13904, U.S.A. E-mail: getinfo@haworthpress.com
There is a critical need for a broader approach that embraces the production, the economics, the environment, and the social challenges facing the rural areas of the United States of America. This book, written by individuals involved in sustainable agriculture research and extension in the region, describes the successes to date, and the impact of programmes on farm economics and the environment. The authors go beyond what has been done so far to project the needs for the coming decades. They provide alternatives to industrial agriculture, considering those that can help move towards a more secure and equitable food system.

Documentation for change

ILEIA's Documentation programme has had a good start in 2007. In March, together with issue 23.1, we distributed "Learning from experience", the documentation manual which ILEIA developed and which we have since been working with. We are now very pleased to say that our partners in Peru and Brazil have distributed a Spanish and a Portuguese version of this manual to their subscribers in Latin America, and that they are using it as part of their documentation activities. Our partners in Senegal and China are also working on producing a French and a Chinese version, both of which will be available soon. We hope these will encourage more documentation efforts in West Africa and in the Far East – and therefore more LEISA experiences to share with all our readers.



"*Aprender com a prática*", the Brazilian edition of our documentation manual.

Throughout this year we have supported several documentation efforts, all of which are already showing interesting results. These include, for example, the preparation of two training modules, articulating the information available and the knowledge of local professionals working with the Tihama Development Authority, in Hodeida, Yemen. Focusing on livestock improvement and on the promotion of indigenous trees, these efforts are co-ordinated by the Spate Irrigation Network. Through AS-PTA, our partners in Brazil, ILEIA has also supported the Brazilian *Articulação Nacional de Agroecologia* and its efforts in "building agroecological knowledge". As part of a broader set of activities, the members of this network are currently analysing how they have developed their own practices and their research and extension activities. They are looking at their results, the difficulties faced, and documenting their experiences. In Chiapas, Mexico, we are supporting Arte Natura, a local NGO, and its efforts to involve farmers actively in the documentation processes.

Photo: Adriana Galvão Freire

Involving all stakeholders in the documentation process. A meeting with farmers in Licaca, Inhambane, Mozambique.

Photo: Karen Hampson

The SEE team busy at work, deciding which indicators help them to best analyse their work.

We have also run a couple of workshops, using our own methodology in co-ordination with other organisations. In October, for example, we were in Mozambique, running a week-long workshop with VETAID. This is an international organisation working to improve the environment in which animals live, and of the people who depend on them for their survival. VETAID is now documenting best practices from three of their major activities in the provinces of Gaza and Inhambane: the training of "*promotores*", animal restocking, and the establishment of local pharmacies. In a similar way, in November we were in China, working with the SEE Foundation. This is an environmental protection organisation funded by more than a hundred entrepreneurs in China, currently interested in documenting their work in the Alxa region, in Inner Mongolia. The documentation processes have only started with these workshops, and we will continue to support them and also learn from them.

Readers are invited to visit our website, and to contribute to these processes. Your comments and suggestions can be very useful. Visitors to our website will also find links to articles published in older issues of the *LEISA Magazine*, as well as links to other organisations, projects and institutions working around these issues. We have also added a "Sources" section, where you can find –and download– different manuals, methodologies and general information on documentation. This will all be updated regularly. ■

http://documentation.leisa.info