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LEISA

Magazine on Low External Input and Sustainable Agriculture

Small animals in focus

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Magazine on Low External Input and Sustainable Agriculture
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Cover photo
Leading the goats home for the night, Uttar Pradesh, India. Photo: S. Jayaraj, Courtesy GEAG, Gorakpur.

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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 in creating 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 specialized 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.

8 Diversifying small farms in Cambodia

Luke Simmons, Luy Pisey Rith and Taing Soksithon

Decades of civil war have led to the destruction of the traditional, diverse farming systems in Cambodia. They have been replaced by rice cultivation and as a result many people suffer from food shortages and poverty. PADEK, a local NGO, is assisting farmers to increase their food security by diversifying their rice farms through the integration of other crops and livestock. The authors describe the process of change on three farms in different parts of Cambodia. Diversification has enabled farmers to provide for the needs of their families and earn a good living. At the same time, their dependency on external inputs has been reduced.

16 Improving the performance of indigenous sheep breeds

Bernardo Fulcrand Terrisse

In many parts of the Peruvian Andes the keeping of indigenous breeds of sheep is part of the traditional culture. Farm families depend on the sheep for meat, wool, manure and some income. Indigenous sheep have, however, consistently been neglected by researchers, extensionists and government officials, and this has contributed to a very low productivity. During the last few years farmers and NGOs have become aware of the situation and are working to improve these indigenous breeds. The farmer's association ACOC, supported by the NGO Arariwa has developed a breeding programme based on proper selection and this has led to increasing quality and productivity of the sheep herds, as well as increasing interest amongst farmers to improve other aspects of livestock management.

DEAR READERS

We have improved the search facility on the LEISA website to make it easier for visitors to find the information they may be looking for. This is how you do it: Go to the LEISA website www.leisa.info and select "search" in the main menu. A form will appear. Here you can enter one (or several) words and the search machine will find articles, a book or an author for you. The search machine searches on title, author, summary as well as on the full text of articles and documents. We hope that this improvement will enable you to use the web site more frequently.

You may also have seen that ILEIA has been looking for new editors. After a thorough selection process we are glad to announce that we have found three very qualified persons who will join ILEIA during the coming months. The three persons are:

- **Jorge Chavez Tafur** from Peru, where he has been working with LEISA Revista de Agroecología and as a consultant.
- **Karen Hampson**, a British tropical agronomist, until recently based in Brazil but with considerable experience also from Africa and the Philippines.
- **Rik Thijssen**, until recently based in Indonesia where he worked as an adviser in sustainable agriculture and with SALAM, the Indonesian edition of the *LEISA Magazine*.

We are certain that they will be able to contribute to the further development of knowledge on LEISA, as well as to many interesting new issues of the *LEISA Magazine*.

The Editors

The contribution of small animals

Editorial

The keeping of livestock is a part of most farming systems, from pastoral systems in which people rely solely on their animals, to extensive livestock keeping as a complement to the cropping activities, to situations where livestock keeping is an integrated component in intensified agriculture. The importance of livestock keeping lies primarily in its ability to convert biomass that is not directly useful for humans (grass, leaves, twigs, agricultural waste-products) into animal products and services that are. Not only do livestock provide highly nutritious milk, eggs and meat, but also feathers, fibre (wool) and hides. In addition, they provide nutrient rich manure which can be used in the growing of crops. Larger livestock are often used for transport purposes and provide draught power. The manure can also be an important source of energy for the farm. As the animals may live for many years, they often serve as security for difficult times, like a savings account, to be used in times of crisis. In this way, the animals themselves as well as the way in which they are kept and utilized is closely related to the particular environment in which the livestock keeping takes place. Man and animals have developed together over time and in most traditional societies, this relationship is reflected as an essential part of the culture.

In the conventional agriculture of today, however, the major focus has been on simplifying the production process and on maximizing the yield of the final product, be it grain, meat or milk. In this process, an increasing amount of external inputs have been used to achieve the production goals and research has been focused on developing animal breeds which respond well to increased amounts of nutrient rich feed. As a result of this, grain production and livestock production have become increasingly specialised and separated from each other. The grain is grown with inorganic fertilizer and the livestock are fed on this grain. In this way, livestock production has lost its role as a complement and support to agriculture and has become a competitor for grain which could otherwise be consumed by humans.

Livestock in small scale farming

For most small scale farmers, for whom it is important to make optimal use of available resources, livestock still has an essential role to play. In this issue of the LEISA Magazine, we take a closer look at how livestock can be integrated into diverse farming systems and in particular at the importance of smaller livestock for poorer households. Factors that smaller livestock such as sheep, goats, rabbits, ducks, chickens and many others have in common, are that they are relatively undemanding in their feeding requirements and easy to house and manage. They provide the same products and services as larger livestock, such as cattle, but are less risky, are easier to replace as they are not so costly and reproduce faster. By optimising the management of the animals as well as the integration of the animals into the farming system, the total production of the farm can increase considerably. The raising of small animals also offers opportunities for a regular cash income throughout the year. Small animals are often cared for by women and children, and the introduction of milk goats to HIV/AIDS affected families in Tanzania has proved to be a viable strategy in improving the nutritional status of these families (Kinsey, p 18).

In many cases, existing systems can be improved by integrating the different components in a better way. Jianbo (p 22) describes how researchers in China are promoting the integration of chickens into an existing agroforestry system based on bamboo. Keeping chickens and growing bamboo are both common - but separate - systems in the area. By introducing chickens into the bamboo forests a more efficient use of the land is achieved, nutrient cycling is enhanced and additional income generated. Daniel (p 12) provides an example of the development of vermicomposting in India, which has led to increasing demand for vermicompost to improve the soil, but also to income generation for landless women. In Vietnam, the introduction of goats and fodder crops into upland farming systems has improved the total farm production and given a substantial increase in income (Van Hao, p 11). Ogle (p 30) describes an initiative to train researchers for the further development of livestock based small scale farming systems.

It is also possible to combine different livestock species in such a way that they complement and support each other. Juniati (p 29) describes how an Indonesian farmer adapted the existing rice-fish farming system by integrating chickens with the fish component on the farm, thereby obtaining a higher and more constant income from the fish as well as the chickens. Another example of integration of different livestock species, in this case rabbits, guinea pigs and chickens in an urban setting, is given by Sánchez (p 28).

Small livestock are also an important source of cash income. In Peru, guinea pig meat is highly valued and Gomero (p 14) describes how he has built an integrated farm where the raising of guinea pigs is the key component and the main source of income. The manure produced by the guinea pigs and the other animals on the farm is carefully used in various ways to provide nutrients for the crops.

Many traditional production systems are under increasing pressure, or have changed or disappeared due to social, economic or political changes. Unnikrishnan (p 36) describes how social changes and changes in agricultural practices have made traditional duck farming in India increasingly difficult, and how farmers have made successful adaptations to the duck keeping system and still manage to maintain it. In Cambodia the long civil war resulted in loss of agricultural knowledge and thereby also in loss of the traditional, diversified farming systems. These systems were replaced by monocultures of rice. Increasing problems with maintaining the rice yields and surviving on the rice production has led to an effort to diversify the farms into integrated production systems similar to those existing before. Small livestock are a major component in this diversification (Simmons, p 8) and the presence of (small) animals and an optimal use of the manure produced on the farm are two essential criteria in striving towards sustainability.

Taking care of small animals

The productivity of livestock depends on a number of different factors including the breed, how well the animal is adapted to its environment, general care, the quality of feed supplied, housing, protection from predators and the quality of health care provided. To increase the productivity of small livestock in a sustainable way, all these factors need to be optimized.

Indigenous breeds

One key consideration is the selection of breed. Exotic or "improved" breeds have been widely promoted because of their high production potential, often replacing local breeds. However, the exotic breeds are often not well adapted to their new living

conditions. This makes it difficult to keep the animals healthy and leads to low productivity. Local breeds, on the other hand, are well adapted to the environment and to the farmers' management practices. They tolerate heat or cold well, can cope with low quality feed and have low maintenance requirements. Animals adapted to arid environments have lower water requirements. Indigenous breeds are often resistant to or can tolerate diseases that can be deadly to exotic animals. To realize the genetic potential of indigenous breeds better quality feed and selective breeding is necessary, but unfortunately research and extension has so far shown little interest. Directly related to the neglect of indigenous breeds is the problem of inbreeding. Inbreeding increases the incidence of genetic diseases and lowers productivity.
Fulcrand (p 16) describes how farmers and technicians have tackled this problem in indigenous sheep breeds in Peru by setting up a breeding programme based on proper selection of breeding animals. This initiative has led to improved production while the beneficial traits of the local breeds are maintained.

Feed
The supply of nutritious and well balanced feed is another important aspect in the management of livestock, as improved feeding gives healthier and more productive animals. Realizing this, Emuria, a Kenyan farmer, was able to build a healthy stock of goats by buying cheap, undernourished animals and providing them with good fodder and the necessary care (Jeremiah, p 31).

The availability of sufficient amounts of high-quality local feed is important for small-scale farmers, who usually do not have the resources to buy animal feeds. By making efficient use of the farm, fodder crops can be grown without occupying land necessary for the production of food crops (Preston, p 6). In addition, extensive indigenous knowledge often exists about which local plants can be used to feed small animals, especially during periods of drought and fodder shortage. Research has also come up with novel feed sources that are highly nutritious and can replace commercial feed (Pillai, p 26).

Animal health
The use of locally adapted breeds and the supply of good feeds are important for obtaining a stock of healthy animals, which is the first step in avoiding disease. In addition to good fodder, animal sheds should be suitable and kept clean, high animal densities should be avoided and general hygiene is essential when caring for livestock. Nevertheless, general management practices alone cannot prevent losses caused by a number of diseases and specific measures to control these diseases may be required. Historically, people have managed to control animal diseases to some extent by using traditional cures and medicines. This ethno-veterinary medicine is still important and merits attention. Conroy (p 24) describes how ethno-veterinary knowledge was used to develop a treatment against gastro-intestinal parasites in goats, thereby offering a local alternative to an expensive commercial de-worming drug. Novel technologies, for example vaccines, also play an important role in preventing disease. Newcastle disease, a viral disease in chicken, can cause very high levels of mortality, but recently a new vaccine has been developed. The vaccine is available in small doses and does not require refrigeration, qualities which make it possible for small-holders to make use of it. The vaccine will reduce mortality considerably. Apart from diseases, predators also pose a real threat to small livestock. In most cases farmers have found ways to cope with this problem, but it requires attention.

A people-centred approach

Technological issues are important in small livestock management, but cannot be separated from the social and environmental context in which the animal is being raised. By working closely together with the local population and jointly analyzing a situation, major bottlenecks can be identified and common action can be taken to overcome them. This is part of an empowerment process whereby farmers obtain important information and organize themselves to carry out necessary change. The establishment of farmer organizations, cooperative networks or self-help groups may be necessary in order to gain better access to outside services such as credit, animals, information and markets, or to improve community collaboration to successfully implement joint undertakings (Zoebish, p 20).

Small livestock make valuable contributions to farming systems and to people's livelihoods. They are of special value to poorer households and should therefore be part of national and international poverty reduction strategies. This awareness should be translated into policies that support the development of integrated farming including small livestock production systems suitable to cultural and social realities. A people-centred approach will help ensure that the most critical issues, technological, social or economic, are addressed and that changes will lead to lasting improvements for farmers as well as for society as a whole. ■

Call for articles

Issue 22.1, March 2006
Documenting for change
Agriculture or natural resource management projects often aim to improve the productivity of and/or regenerate natural resources. But how do you know what the results and impacts of your undertakings are? And how do others get to know about the results? A thorough documentation of what you have been doing as well as of the outcomes will make it possible to monitor and evaluate your activities and further improve them. On the basis of this documentation, it is also possible to inform others of your experiences and findings.

Documentation can take many forms; from short field observations, records of inputs and outputs, to multidisciplinary scientific findings at a more detailed level. However, the aim is the same: To try to understand what has been going on so that we can improve our work and get better results. But how do you go about it? In this issue we would like to highlight examples of processes and methodologies which have helped people to document, analyze and further develop their activities.
Deadline for contributions is 1 December, 2005.

Issue 22.2, June 2006
Agriculture in transition
Many of the different agricultural systems practised today have one thing in common – they are under severe stress and are increasingly failing to meet the needs of the producers. In this issue of the LEISA magazine we would like to examine how farmers manage the transition process towards more sustainable farming systems and how they can be supported by fellow farmers, outside organisations, or external incentives. We would also welcome examples of how institutions have adapted to be able to support these processes better.
Deadline for contributions is 1 March 2006

The advantages of small animals in farming systems

Reg Preston

Farming systems can be roughly divided into on the one hand large scale, highly mechanized and energy intensive systems managed as corporate agri-businesses and on the other hand small-scale farms, which employ family labour and use limited external inputs. In the small systems, a closer integration of the different components, recycling and optimized use of local resources can enhance productivity. This approach aims to imitate the functioning of natural ecosystems, which are sustainable, primarily because the inputs are provided by nature. In the small integrated farm the livestock component has a central role to play. In addition to providing meat and other animal produce the animals are important for the recycling of residues and wastes, converting these from sources of pollution into valuable inputs such as organic fertilizer or biogas. The selection of appropriate livestock species is therefore an important consideration in the development of an integrated farming system. This article argues that smaller species of animals are more appropriate than larger ones.

In a farming system the components to be considered include the cropping system, the animal system and the management of the whole farming system, as well as the recycling of animal manure.

Cropping systems

Prior to the industrialization of agriculture and the increasing dependency on oil, farming practices were in general more sustainable, simply because fewer external inputs were available. Soil fertility was maintained though fallow, use of leguminous plants either in mixed swards or as rotational crops and livestock often played a valuable role as a source of manure, and to provide the power for soil cultivation and for transport.

These basic features of sustainable farming systems are still relevant, but can be considerably enhanced in the light of new knowledge and opportunities. The opportunity is to be found at the heart of the energy crisis, which will result from the reduced availability of oil. This will mean that farm-produced energy will have increasing value as one of the outputs of the farming system, and as a replacement for previously purchased energy (liquefied gas or kerosene). Fibrous biomass is likely to be one of the most important sources of alternatives to oil. This creates an opportunity for more diversified cropping systems and especially the promotion of perennial tree crops, many of which fix atmospheric nitrogen, and of sugarcane, which is the most efficient of all crops for converting water and carbon dioxide into biomass through photosynthesis. Pasture is not an option as it is almost impossible to economically recover the fibrous components not eaten by the grazing animal. "Cut-and-carry" systems facilitate the separation of biomass into edible (leaves for feed) and non-edible (branches and stem for energy) components. This in turn will put emphasis on those crops which are easy to harvest and need less time and effort to cut and carry the biomass to the point of utilization. When this is taken into consideration, it is found that farmers prefer *Gliricidia*, mulberry and cassava over *Leucaena*, because of the greater time required to harvest a given weight of *Leucaena* compared with the foliages of the others. As well as feed and fuel, small farms should also produce materials that can be used to meet the construction needs of the family and their livestock. This points once again to the advantages of crops that have multi-purpose uses. Thus, from sugarcane, the dry leaves can be used as roofing material (see later section), the juice as energy feed for pigs, the bagasse for fuel energy and for bedding, and the tops (leaves plus growing points) for goats and sheep.

Efficient feeding

As in the pre-oil age, livestock will be an integral component of the new farming systems. In addition, the proposed cropping systems will provide comparative advantages for the smaller livestock species, especially goats, sheep, rabbits and pigs. The overhanging threat of bird flu, with the potential to spread from South-East Asia to the rest of the world through migratory birds, puts a serious question mark over the future of poultry other than in a minor scavenging role, the loss of which will not prejudice the economic viability of the overall farming system.

Photo:Nguyen Van Hao

Hanging the foliage (Gliricidia) on the walls of the shed stimulates feed intake; note the slatted floor which keeps the goats dry and clean and facilitates collection of the manure.

Beyond the classical arguments for small livestock species – lower investment, facility in marketing the products, adaptation to the management skills of women and children – can be added the appropriate nature of their feeding behaviour and digestive system for utilizing the products of the crops that will have new significance as joint producers of feed, energy and construction materials, in integrated farming systems.

The browsing habits of goats make them especially suited to consume the foliages of tree crops, the stems and branches of which will be the feedstock for electricity generation through gasification. By contrast, the grazing preferences of sheep will often be satisfied by the herbage available on the ground in the tree plantation. They have also proved to be especially suitable

for grazing the access paths among plots of sugarcane, as they do not find standing cane an attractive feed source.

In lowest income families, pigs are often managed as scavenging animals; however, apart from the difficulty in controlling them and preventing damage to crops, scavenging systems also make inefficient use of manure. When energy is at a premium, the opportunity to convert pig manure into biogas for cooking and effluent for fertilizer for crops and fish ponds, will be equally, if not more, important as the income from the sale of the animals.

This leads to the question of which breeds or strains of livestock will be most appropriate in the integrated farming system. Local "unimproved" breeds are usually viewed negatively by the animal scientist, because of their low rates of growth or of milk production. However, for an animal to express its genetic potential for high productivity requires feeds of high nutritional value, and these are usually not the feeds that can be produced when the available resources are solar energy, soil and water, with minimum external inputs. An equally important point in this equation is that purchased "high performance" feeds are highly digestible, which means that less manure is produced, than if local feeds of lower digestibility (and lower cost) are used. Less manure results in less biogas and less fertilizer. When the added value from the manure is taken into account, animals of lower productivity may be more appropriate.

Rabbits are one of the small livestock species whose unique digestive system has not been adequately exploited by conventional research. Like other hind-gut fermenters such as the horse and deer, rabbits have the combined advantage of the monogastric and ruminant modes of digestion. Unlike in other livestock species, a low content of fibre in the feed leads to poorer feed utilization efficiency. These physiological advantages are not utilized in the typical systems used in the industrialized countries where feeds for rabbits mainly consist of cereals and oilseed meals. In contrast, recent research in South-East Asia is showing that acceptable levels of performance in rabbits can be achieved with diets of 100 percent foliage derived from a crop (water spinach – *Ipomoea aquatica*) with a very high biomass productivity, and capacity to use organic manures efficiently. This research, which is especially relevant in the context of small scale integrated farming systems, is leading to increasing interest in rabbit production in South-East Asian countries, where the threat of renewed outbreaks of bird flu has stimulated the search for alternatives to poultry meat.

Disease

Small animal species are as subject to disease constraints as the larger species. However, when the interaction of the species with the other components of the environment – nutrition, housing and management – is taken into account then goats certainly, and sheep to some extent, present comparative advantages in terms of susceptibility to internal parasites.

In a number of studies it has been shown that when goats are managed in a "cut and carry" system, in which the feeds are foliages of trees and shrubs (as opposed to grasses) then the incidence of intestinal nematode parasites is negligible, making the regular use of chemical de-worming unnecessary. The main reasons appear to be that the infective nematode larvae do not develop in the foliage of trees and shrubs, but need the specific micro-environment found in grass swards. A secondary factor may be the presence of tannin-like compounds in the leaves of shrubs such as cassava. Whatever the reason, goats in an intensive "cut and carry" system making use of tree and shrub foliages as the feed, are less prone to infections by parasite nematodes, than when they are managed under extensive grazing.

Housing

When land is in scarce supply, as is invariably the case in small scale family farming systems, grazing is rarely a management option. Even in upland areas, where land resources are more plentiful, farmers generally find it convenient to house their animals at night time, for their protection and because this facilitates the collection of the manure. A general advantage of small livestock species is that their housing needs are simple. The production of modern construction materials, such as cement and bricks are energy-dependent and prices will eventually rise in line with the oil price. In most countries, and especially those in tropical latitudes, all the construction materials required for housing of goats, sheep and rabbits can be grown on the farm and are recyclable. In the design of housing for small livestock species, the first consideration should be the provision of an efficient means to recycle the wastes.

Recycling of manure

The manure from different animal species has different physical and biological characteristics which must be taken into account when deciding on which recycling method to use. The excreta from pigs and people is offensive to handle and it is best processed through a closed biodigester. The manure from goats, sheep and rabbits is not offensive, but it is not a suitable substrate in a simple biodigester system (see *LEISA Magazine* 21.1). The pellet-like nature of the manure causes it to float on the surface of the liquid inside the biodigester, and scum formation becomes a problem. This kind of manure is better recycled through earthworms. It is convenient to house sheep, goats and rabbits on raised slatted floors. It is then a simple procedure to add some earthworms to the manure that has fallen through the floors. Any feed residues can be combined with the manure. Irrigating the earthworm beds with the effluent from the biodigester will speed up the process of decomposition and growth of the worms. The residue from this process (vermicompost) can be removed at intervals and used directly as fertilizer.

Conclusion

In a world faced with declining oil supplies, the comparative advantage will shift from large scale, oil dependent, farms to small scale integrated farms producing most of their needs, including energy, from natural resources. In such a scenario, small livestock species, especially pigs, goats, sheep and rabbits are the most useful animals, in particular in view of the low investment, reduced risk, adaptation to recycling systems, capacity to use local feeds and easy management by family members.

■

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Diversifying small farms in Cambodia

Luke Simmons, Luy Pisey Rith and Taing Soksithon

Introduction

Rice is the most important crop in Cambodia and the vast majority of farmers rely on it for their food security. Since the early 1980s, much effort has gone into resurrecting Cambodia's agricultural systems and infrastructure following the damage caused by decades of civil war. Initially this work focussed on rice production, rice varietal improvement and repairing irrigation systems. Overall, this has been successful and at the national level the country has achieved a small rice surplus every year since 1995. However, analysis of the situation at the local level provides a less positive picture. Nearly half of the 24 provinces in Cambodia face food deficits with many families not being able to produce enough rice for their own consumption, leading to high levels of chronic malnutrition among children. Added to this, there is increasing pressure for land caused by a rapidly growing population.

Photo: L. Simmons

Mr Kheit Leam talking with friends about his farm improvement plans.

Cambodian farming systems need to be diversified, so that a greater range of crops and livestock are produced and food security guaranteed. Farm components also need to be integrated for improved production and environmental benefits. A local NGO called *Partnership for Development in Kampuchea* (PADEK) is helping farmers to improve their food security by providing affordable credit through self help groups and establishing a community-based agricultural extension network comprised of sustainable agriculture, livestock and fisheries experts who are selected and trained as service providers for their communities. This article presents the experiences of three Cambodian farmers who have used the training and support from PADEK to diversify and improve their farming systems. A checklist of sustainability criteria applicable to Cambodian family farming systems is used as a framework for comparing the three farming systems and highlighting areas where further improvements could be made.

Mr Khut Khoeun

Khut Khoeun lives with his wife Sam Thoun, their four daughters, two sons and two granddaughters in Romchek commune, Prey Veng Province in south-east Cambodia. Twenty years ago they established their own farm. For many years the family grew only rice and struggled to get enough food to eat. Over the years the number of family members increased but the size of the farm stayed the same and Khoeun knew that they had to improve their farming system if they were going to be able to feed everyone, pay for education and healthcare and improve the family assets.

In 2002, PADEK started to work in Romchek commune and began to train farmers on new crop and livestock production techniques, compost making and the benefits of ecological agriculture. Khoeun's family was inspired to try some of these techniques and they haven't stopped experimenting and improving their farm since. They have reshaped their farm into a series of canals, ponds, rice fields and banks for growing a great diversity of fruit, vegetables and herbs and raising livestock. All of the rice produced on their 2.1 hectares of rice land is needed to feed the family, so they concentrate their income-generating activities on their 0.35 hectare homegarden by growing a locally adapted herb, called eryngo (*Eryngium foetidum*) and a number of other crops such as cassava, gourds, chilli and lemongrass (*Cymbopogon citratus*), which they sell in the local market. The family also raise cattle, pigs, ducks and fish on their farm. The cattle are used for ploughing the rice fields and their dung is used to make compost. They are fed rice straw and allowed to graze on the grass growing along the banks of the rice fields. The pigs and ducks are kept in cages underneath the house and are mostly raised for consumption by the family. They are fed with rice bran, broken rice and vegetable wastes. The family have been experimenting with a nutritious pig feed made from the chopped stems of old banana plants, mixed with salt and palm sugar and their pigs have responded well. Two varieties of fish, common carp (*Cyprinus carpio carpio*) and silver barb (*Barbonymus gonionotus*) are raised together in ponds located in the homegarden. They are fed with rice bran and also feed on duckweed, a small aquatic herb that grows in the pond. Some animal manure is periodically added to the pond to stimulate the growth of the duckweed and other aquatic plants, for the fish to feed on.

Mr Kheit Leam

Kheit Leam lives with his wife Em Sarin, three sons, one daughter and her husband and three grandchildren in Por Chamroeun commune, Kampong Speu Province in the south of Cambodia. The family has been member of a self-help group since 1995. The members of the group meet once a month to deposit money into a group fund from which members can take loans. Mr Leam thinks that the self-help groups are an excellent way of saving and borrowing money and helping other people in the community in times of need. They are also a good opportunity to share new farming techniques and to learn from each other. The family has been able to use loans from the group and some of their own savings to buy a rice mill, piglets and chickens for their farm. The production of chickens and pigs is now one of their main income-generating activities.

Before 1995, the food security of the family was not good. They only grew rice on their farm and were heavily dependent on harvesting timber and fuelwood from the forest for additional income. After PADEK introduced self-help groups and new farming techniques to the area, the family began converting some of their rice land into vegetable gardens, fruit trees and ponds for irrigation. They began to grow new crops, such as peanuts, watermelons, cucumbers, tiger paw yams (*Dioscorea* sp.) and longbeans (*Vigna unguiculata*) and to raise chickens, pigs and cattle. They have built new pens for their livestock close to their house and a compost pit, which has facilitated feeding and the collection of manure.

Since diversifying their farm the family now has a relatively small area of rice land, only 0.82 hectares, but they manage this very intensively. In 2003, they started to experiment with the System of Rice Intensification (SRI) on their farm. Rice yields have improved to 3500 kg/ha, almost double the national average, and they have reduced their use of chemical fertilizers from three to one 50-kg bags of NPK, by increasing their use of compost. In the future the family plans to convert even more rice land into ponds for fish production.

Mr Kroch Khorn

Kroch Khorn lives with his wife Chhan Chun and their four children in Leang Dai commune, Siem Reap province, north-west Cambodia. They moved to the area in 1983 because they needed more farmland to support their growing family. However, life was a struggle for many years due to deficient water supply, poor soil fertility and ongoing fighting in the area. Things started to improve in the late 1990s when the fighting ended and in 1999, the family joined a self-help group and was able to save money and take out loans from the group for improving their farming activities and household assets. Most of the livestock and crops produced on the family's 2.9 hectares of rice land and 0.43 hectare homegarden are for subsistence, but as they have become more food secure they are starting to grow some additional crops for income generation.

In 2004 the family constructed a pump well in their homegarden. This has allowed them to start growing pesticide-free vegetables for hotels in the nearby town of Siem Reap. In their first year they made a good profit from this activity. However, rice yields in 2004 were very low due to a drought, exacerbated by the very low inputs of labour and compost that characterize traditional practice in the area. The family raise a small number of cattle, pigs, chickens and ducks on their farm. Cattle are used for ploughing the rice fields and the other animals are mostly for home consumption, although they are occasionally sold when the family needs additional income.

Next season the family plan to experiment with the SRI rice growing system. They also plan to plough their rice stubble into the field instead of burning it and to apply more compost on their fields in an effort to improve rice yields. They plan to grow nitrogen-fixing trees and crops such as sesbania (*Sesbania rostrata*) and swordbean (*Canavalia gladiata*) around their homegarden to be used as ingredients for compost making. They also want to build pens for their cattle, pigs and ducks close to their compost site, allowing for easier transfer of manure to the compost heap.

Sustainability of Cambodian farming systems

It is generally agreed that for agriculture to be sustainable it must be economically viable, environmentally sound and socially acceptable. Sustainability is a moving target and dependent on the time and location in which it is considered. Therefore, a farming system that is sustainable in one location or society may be completely inappropriate elsewhere. Likewise, a farming system that appears to be sustainable now may become unsustainable in the future if conditions change. A checklist of sustainability criteria for family farming systems in Cambodia was developed by PADEK to help assess the effectiveness of their food security programme (Table 1). The checklist is not supposed to give a conclusive answer as to whether a farming system is sustainable or not, but it does give an indication of progress and shows areas where improvements could be made in the future.

The checklist was used to compare the three farming systems described above (Table 2). All input and output data were >>

Table 1. Checklist of sustainability criteria for farming systems in Cambodia

Checklist for sustainability of rice crops

- Apply 5-10 ton/ha of good quality compost annually[1]
- Grow leguminous green manure crop prior to, or after the rice crop
- Plough rice stubble into the field (not burn it)
- Rice straw made into compost or fed to animals and manure used in compost
- The use of chemical fertilizers reduced and replaced by organic fertilizers and nutrient cycling
- Use of botanical pesticides rather than chemical pesticides
- Apply the principles of the System of Rice Intensification
- Save own seed for planting each year
- Irrigation system of ponds and canals integrated into the farm
- Return yields of greater than 2 ton/hectare[2]
- Return profits of greater than US$1.00 per labour-day[3]

Checklist for sustainability of secondary crops, vegetables and fruit trees

- Growing a diversity of trees and crops to optimize the use of space, light, nutrients and water
- Apply more than 5-10 ton/ha of good quality compost annually
- Apply liquid compost, Effective Micro-organism (EM) and Biological Extracts (BE) to crops
- Grow crops in rotation across different fields
- Use of mulch to protect the soil and conserve water
- Crop residues made into compost or fed to animals and manure used in compost
- Grow a green manure crop on the field each year
- The use of chemical fertilizers reduced and replaced by organic fertilizers and nutrient cycling
- Use botanical pesticides rather than chemical pesticides
- Save own seed for planting each year
- Irrigation system of ponds and canals integrated into the farm
- Return profits of greater than US$1.00 per labour-day

Checklist for sustainability of livestock production

- Animals kept in appropriate housing that is cleaned regularly
- Animal manure used in biodigesters, fishponds or for compost
- Animals vaccinated against common diseases
- Animals fed a nutritious diet of locally available fodder
- Return profits of greater than US$1.00 per labour-day

Checklist for sustainability of fish production

- Raising a diversity of fish species
- Fish raised in pond that is integrated with the homegarden, rice fields or animal pens
- Pond has available water for more than 6 months of the year
- Use locally available feed such as duckweed, rice bran and phytoplankton
- Return profits of greater than US$1.00 per labour-day

[1] Good quality compost should be made in a shaded area using a variety of materials such as manure, straw, leaves and other crop residues. It must not be left in the field in the sun or the rain for too long and should be ploughed into the soil prior to crop planting. The amount of compost that should be used varies depending on the soil type and crop variety but this range is a good guide for high crop yields and sustained soil quality.

[2] This is approximately the national average rice yield in 2003.

[3] Achieving a profit of greater than US$1.00 per labour-day would at least mean that the farming activity is returning a benefit roughly equivalent to other labouring sectors in Cambodia. In the case of subsistence crops, the value of the crop in the local markets should be used for the estimation of the value of the crop.

>> calculated on a per hectare basis to allow for comparison between the systems. Khut Khoeun and Kheit Leam are both making a profit in excess of US$1.00 per labour-day for their rice farming, while the rice farming of Kroch Khorn could be improved through greater attention to soil fertility and water management. All the farmers are making a good profit from growing secondary crops and vegetables. Khut Khoeun and two of his family members are employed almost full time growing crops on their 0.35 hectare homegarden and each make a profit of US$1.20 per labour-day. The other farmers make greater profits per labour-day for their secondary crops but they are not employed full-time on their farms and make a lower profit per hectare than Khoeun, who manages his homegarden more intensively.

All farmers use reasonably large amounts of compost on their secondary crops, between one and ten tons per hectare, depending on the crop type. Cattle, pigs and poultry are vitally important for their manure, which is combined with rice straw and other crop wastes to make this compost. However, all farmers mentioned that they did not have as much compost available as they would like and also used other methods for managing soil fertility including: green manures, mulching, crop rotations and liquid composts. Two of the farmers still used some chemical fertilizers on certain crops, but they plan to reduce this in the future by growing more nitrogen-fixing trees and crops on their land and collecting more biomass to make compost.

All farmers were using improved techniques of livestock production such as housing their animals in clean cages, feeding locally available and nutritious fodder and vaccinating their animals against common diseases such as Newcastle disease in poultry, swine fever in pigs and haemorrhagic septicaemia in cattle. The vaccines are bought from the Village Livestock Agents that PADEK has trained in each village. Only one of the farmers, Kheit Leam, was raising animals for sale and the majority of his farm income was derived from selling livestock, primarily pigs and chickens. Khut Khoeun was the only farmer raising fish on his farm, although Kheit Leam planned to start in the next year, after constructing a fishpond.

Conclusion

The three farm families presented in this case study all have different farming systems and income generation strategies, but they demonstrate that with hard work, careful planning and the diversification and integration of crop and livestock components, it is possible to earn a good living from farming and provide for their needs, while reducing the use of external farming inputs such as chemical fertilizers and pesticides. They also illustrate the importance of working together with friends and neighbours and sharing ideas and resources to improve the lives of everyone in the community.

Farm diversification may lead to increased workloads for the family. The three families of this study did not mention increased labour as a constraint, but this may be a potential barrier for other farmers. However, many farmers in the area are not employed for the full year on their farm and males often go to the city in the dry season to search for a job. Diversification activities, especially those involving vegetables but also fruit trees and livestock, may allow farmers to stay working on the farm in the dry season and make an income without depending on labour opportunities in the city.

■

Table 2. Overview of farm production for Khut Khoeun, Kheit Leam and Kroch Khorn

Farming subsystem	Khut Khoeun	Kheit Leam	Kroch Khorn
Wet season rice production			
Amount of compost and manure (kg/ha)	1500	2439	207
Grow a green manure crop	No	Yes	No
Rice stubble ploughed into the field	Yes	Yes	No
Rice straw used for fodder and compost	Yes	Yes	Yes
Amount of chemical fertilizer (kg/ha)	0	61 (NPK)	0
Use chemical pesticides	No	No	No
Apply principles of SRI	Some	Some	No
Save own seed for planting	Yes	Yes	Yes
Irrigation system available for rice fields	Yes	Yes	No
Yield (kg/ha)	1500	3512	166
Profit per labour-day (US$)	1.60	1.05	0.35
Annual profit per hectare (US$)	210.30	522.55	11.55
Secondary crops and vegetables			
Growing a diversity of crops and trees	Yes	Yes	Yes
Amount of compost and manure (kg/ha)	3000-10 000	1250-5000	3000-10 000
Apply liquid compost, EM and BE	Yes	No	No
Use crop rotations	Yes	Yes	Yes
Use mulch to conserve water	Yes	No	No
Crop residues made into compost	Yes	Yes	Yes
Grow a green manure crop	No	No	No
Amount of chemical fertilizer (kg/ha)	0	0-100 (NPK)	0-100 (NPK)
Use chemical pesticides	No	Some	No
Save own planting material	Yes	Some	Some
Irrigation system in homegarden	Yes	Yes	Yes
Profit per labour-day (US$)	1.20	4.40	2.90
Annual profit per hectare (US$)	3048.05	309.40	484.60
Animal production			
Appropriate and clean animal shelter	Yes	Yes	Yes
Manure used for compost	Yes	Yes	Yes
Animals vaccinated against disease	Yes	Yes	Yes
Animals fed a nutritious diet of local fodder	Yes	Yes	Yes
Profit per labour-day (US$)	Unknown	Unknown	Unknown
Annual profit (US$)	0	754.25	0
Fish production			
Fishpond integrated into farm	Yes	Yes	No
Pond has water for greater than 6 months	Yes	Yes	N/A
Raising a diversity of fish species	Yes	No	N/A
Fish raised on locally available feed	Yes	N/A	N/A
Profit per labour-day (US$)	Unknown	N/A	N/A
Annual profit per hectare (US$)	306.10	N/A	N/A

References
- McKenney B., Prom T. 2002. **Natural resources and rural livelihoods in Cambodia**. Cambodian Development Resource Institute, Phnom Penh.
- Murshid K.A.S. 1998. **Food security in an Asian transitional economy: the Cambodian experience**. Cambodian Development Resource Institute, Phnom Penh.
- UNDP 2004. **The macroeconomics of poverty reduction in Cambodia**. United Nations Development Programme, Phnom Penh.

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Crop-goat integration

Nguyen Van Hao and Than Xuan Dong

Most Vietnamese farmers are smallholders, usually with between 0.5 ha to 2 ha of land per household. A typical holding consists of a cropping area and a homestead, with the house, trees, vegetables and livestock. The main activity is growing food crops, and livestock production is usually a sideline. The farming systems are often very complex, especially in areas where the environment is favourable for producing many different types of crops and livestock products. The main feed sources for the livestock are crop residues. The manure is applied to the crops as the sole, or as a supplemental, fertilizer. The most limiting factor for livestock production is the inadequate supply of good quality feed throughout the year, especially in the dry season. Leaves from leguminous trees can be valuable as forage supplements in feeding systems based on crop residues, particularly as tree legumes are locally adapted, require minimal inputs for establishment and maintenance, and are readily utilized in mixed farming systems.

This article describes the development and impact of integrating goat production into existing farming systems in upland areas of South-Eastern Vietnam. It shows the importance of integrating agricultural systems that build on the complementarities between the crop and animal systems. Such integration can lead to increased total productivity as well as increased ecological and economic sustainability. The long term aim of the project was to disseminate appropriate technological solutions that would lead to more sustainable farming systems for these particular ecological zones.

Selection of farms and farmers

The study area is located in Ba Ria-Vung Tau province (about 100 km from Ho Chi Minh City), in South-eastern Vietnam. It is an undulating area, with slopes ranging from 10 to 15 percent. The dominant soil types are red and red-yellow podzols with low fertility and organic matter content and a pH of about 4.2. The annual rainfall is 1 600 mm. The wet season starts in May and ends in October.

At the start of the project in 2001, thirty farmers in Xuan Son village, Chau Duc District, were interviewed in order to understand the existing farming systems and economic activities. It was apparent that management of livestock was a marginal activity. Only four out of the thirty farmers kept pigs and only two kept goats. Gross income per farm was very low, on average US$ 420 per year.

The project

Ten farmers from this initial survey group were selected as participants in the project, based on their interest in diversifying their farm activities and specifically in the introduction of a model of crop-goat integration. Goats were considered to be the most appropriate livestock species as they are browsers and prefer leaves from trees and shrubs.

In discussions with the farmers, it was decided to set aside 1 ha of each farm and to divide this into different parts: 0.3 ha for vegetables, 0.5 ha for growing pepper and 0.2 ha for growing guinea grass. The boundaries of the 1 ha were planted with *Erythrina variata, Gliricidia sepium* and *Leucaena leucocephala.* The peppers were established on live poles of *Erythrina variata* and *Gliricidia sepium* in a double row at 2 x 2 m spacing (2 500 plants/ha). Six goats, five does and one buck (local x Anglo-Nubian), were supplied to the participating farmers, with the agreement that a comparable number of offspring from the original animals would later be given to other interested families. The goats were kept in full confinement in simple sheds built by the farmers. The sources of feed were; the branches of the *Erythrina* trees supporting the peppers, which were pruned every two months; the branches from the shade trees in the boundaries of the farm; and the guinea grass. The goat sheds were constructed with slatted floors so that the manure could be collected from beneath the sheds. The manure was utilized for fertilizing the vegetables, trees and grass.

The impact

Growth and reproductive performance of the goats was of a high order, with slightly better results in the wet than in the dry season. The income of the farms increased very significantly, with the proportion derived from livestock representing some 65 percent of the total income (Table 1). The increase in the value of the crop production reflects the use of the goat manure as fertilizer. Before the introduction of the goat/crop model, the average annual gross income was US$420. Four years after implementing the model, the average annual income had increased to US$1983 (Table 1). The internal rate of return over the 4 years of the project was over 800 percent.

Table 1. Development of the cash flow over the first 4 years of the project (average of the 10 farms) US$

	2001	2002	2003	2004
Returns				
Cash income				
Crops	580	862	1425	1400
Goat kids	450	675	900	1012
Total cash income (I)	1030	1537	2325	2412
Value of non-cash income				
Added value of livestock	656	875	1093	1312
Manure	94	100	100	120
Total non-cash income	750	975	1193	1432
Total gross returns	**1780**	**2512**	**3518**	**3844**
Costs				
Supplies	304	170	180	180
Goat house	125	20	20	20
Loan interest	65	53	41	29
Loan repayment	200	200	200	200
Total cash costs (E)	694	443	441	429
Non-cash costs				
Labour	1200	1200	1200	1200
Total non-cash costs	1200	1200	1200	1200
Total costs	**1894**	**1643**	**1641**	**1629**
Net profit	-114.00	869.00	1877.00	2215.00
Net cash return (I-E)	336	1094	1884	1983

Over the four years of the project there was a major uptake from farmers in the region. The numbers of farmers adopting the system increased from 15 in 2001 to 570 in 2004, with the total goat population rising from 120 to 2350. The results of the project show that crop-small ruminant integration can be an important agricultural activity for small land holders. ■

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Photo: Author

Jugra Devi with her vermicompost bed.

Improving livelihoods through vermicomposting

Joshua Daniel, Sucharita Dhar and Jyoti Desai

In the dry tropical regions of India , livelihood opportunities are often closely linked to soil fertility conditions. Although farmers in specific localities have similar social backgrounds and possess similar natural resources, there are often surprisingly drastic differences in their economic status. One of the factors determining the economic well being of farmers is soil fertility. The biological component of the soil, living organisms and dead organic matter, is the major factor limiting fertility of dryland soils. Therefore, improving the biological fertility is a priority of land development programmes. When activities designed for such purposes also provide livelihood opportunities, the potential benefits are much larger.

BAIF *Development Research Foundation*, based in Pune in India, is engaged in improving the livelihoods of rural communities through land-based activities. Most of the projects implemented by BAIF are sponsored by development agencies and a majority of the targeted beneficiaries are marginal farmers. Often, their land is so degraded that these farmers are forced to seek a livelihood elsewhere as migratory labourers. Making them realize that the land they possess can be turned into a valuable asset and encouraging them to return to their farms are therefore primary objectives. BAIF's strategy is to introduce sustainable systems, such as tree-based farming, and encourage practices, such as the use of compost to supplement the biological fertility of soil. Although several methods of composting are practiced, vermicomposting has proved to be the most popular method among participants in BAIF projects.

Vermicomposting

Composting is the process by which biomass is broken down to humus, which has several beneficial effects on soil physical and chemical properties. Further decomposition of humus releases nutrients for crop uptake. A requirement for composting is the presence of organisms that feed on biomass and break it down to physically finer particles and chemically less complex substances. In nature, earthworms and microorganisms decompose dead biomass. This process can also be initiated by the deliberate introduction of earthworms into a stack of biomass, and is then called vermicomposting.

The quality and the state of the biomass available to most BAIF project participants in India influences their preference for vermicomposting compared to other methods of composting. Availability of biomass is limited and much is used for other purposes: farmers use straw, leaf litter and tender stems as fodder for farm animals and hardy stems and coarse leaves are sources of domestic fuel. The remaining biomass, after these immediate priorities are met, is coarse material that does not break down easily. Earthworms are very effective in initiating the decomposition process in such materials and paving the way for subsequent microbial action.

Another source of biomass available to farmers is cattle dung. Normally dung decomposes well by itself, producing farmyard manure of a very high quality but, unfortunately, the dung available to small farmers in India does not decompose well by itself. The animals usually graze in the open, and the dung is dry before it is collected. When dung becomes this dry it lacks the microbial populations required to decompose into farmyard manure. However, it becomes an excellent substrate for vermicomposting when wetted.

The method

The material needed for vermicomposting, on weight basis, is three parts of dry biomass (chopped into pieces of less than 10 cm) and two parts of wet dung. The biomass and dung are mixed well and wetted to have an overall moisture content of 30 - 40 percent. This can be readily estimated by farmers. At this moisture level, a ball made by pressing the substrate particles together breaks up when dropped. If it does not break up, the moisture content is too high whereas if the substrate is too dry a ball cannot be made. The substrate is made into a bed of a suitable length that is 100 cm wide and 50 cm high, and is kept

covered with a wet gunny (loose canvas or other coarse material). A simple shed can be constructed to provide shade for several beds. After two weeks, 200 earthworms are introduced for every 100 kg of substrate. The substrate is stirred and turned once a week, water is sprinkled if it is too dry and the bed remade. After about 45 days the vermicompost will be ready for use.

Livelihood opportunity

Recognizing the potential of vermicomposting in small farm conditions, BAIF introduced it to participants in its development projects in several states of India. A component of many of these projects is to grow fruit trees on marginal land, which requires filling the planting pits with manure and soil. Hence there was a need for manure such as vermicompost at these project sites. Farmers would collect dung and leaf litter from their own farm or from the neighbourhood and make the vermicompost with earthworms supplied by the project. The surface-feeding species of earthworms such as *Eisenia foetida* proved very effective because of their tolerance to the relatively high local temperatures. To emphasize the importance of earthworms, they were not given free of charge: Within three months every recipient was required to "pay an interest" of 200 worms for every 1000 worms they received. As a result, there were sufficient worms to go round in most project locations within a few months time.

As this activity caught on, it was observed that in most farm-holdings, vermicomposting had become the responsibility of women as it required continuous involvement without hard manual labour. The simple production process and flexibility in terms of time needed to attend to the activity allowed the women to readily incorporate it in their routine of household chores. To take advantage of the skills of women in managing this activity and to convert the dung, leaves and other bio-wastes found littered in rural areas, vermicompost making developed into an income-generating activity. In particular, it became an attractive opportunity for landless people in the villages.

Self-help groups, where 10 - 20 like-minded women work together with a common aim, were used to support this development. Groups were given training and the women were quick to acquire the necessary skills and thereafter to manage the activity on their own. Each group received one kilo of earthworms, worth about US$25.00. Sometimes, the women were initially very reluctant to touch the earthworms, but the perseverance of the trainers eventually paid off. Project staff visited the groups regularly to conduct discussions and provide guidance. These interactions helped the women get over their aversion to handling earthworms. The women realized that vermicompost production was a simple activity requiring only a few hours each day, with the entire group able to share the tasks amongst themselves. Each member now collects dung and other biomass from their farms, homesteads and common areas, including forests.

The vermicompost produced by the groups was mostly sold to the BAIF projects for use in the fields of beneficiaries establishing the tree-based system. The availability of a ready market outlet served as an incentive for the vermicomposting groups. As a result vermicomposting has become established as a successful income-generation activity in almost all the areas where it was introduced. In a project location in Gujarat, for example, more than 250 self-help groups comprised of tribal women produced nearly 2 000 tons of vermicompost in a year. The value of this is about US$8 500, a sizeable amount considering the economic status of the local people. The members of the group share the proceeds from the sale of the vermicompost.

Soil fertility

It is imperative that the vermicompost made by Self-Help Groups is used to enrich the fertility of soils within the locality. Ideally, the biomass taken out from a farm by each member of a self-help group should return to the farm in the form of vermicompost. However, this is difficult to ensure as the objective of the groups is income generation. As of now, the main buyer of the vermicompost produced by the groups is the development projects implemented by BAIF, so it remains within the village and used on small farms. Once the project activities are completed, there is a possibility of the produce getting sold to large farmers outside the villages. This export of biomass from the site of its origin is undesirable. It is expected that the experience of the farmers in project villages will result in their buying the vermicompost from these groups for their farms.

Vermicompost made by individual farmers is used for fruit trees as well as annual crops. Some farmers who earlier used small amounts of chemical fertilizers in combination with organic manures are now able to grow their crops with vermicompost alone and get almost the same yield. In general, farmers are introduced to a package of improved practices and application of vermicompost is one of them. Therefore, the quantitative improvement in the productivity solely due to vermicompost use is difficult to ascertain. But farmers often tell about the benefits in different aspects of crop production. An example is how the paddy crop in fields where vermicompost had been applied survived long dry spells during the monsoon season, due to the increase in the water holding capacity of the soil.

Another example of successful use of vermicompost is in a project in Gujarat, where a group of small-scale farmers were encouraged to adopt intensive vegetable production. Each farmer cultivated more than 10 species of vegetables on 0.1 ha of land, with irrigation. The rate of vermicompost application in these fields is 10 - 15 tons per hectare per year. In spite of heavy nutrient extraction through repeated harvests, these farms have been able to sustain their production during the past three years. Several of the farmers are of the view that the fertility of their land has been gradually improving because of the continuous addition of vermicompost.

Sustainability

The sustainability goals of this initiative are two-fold: firstly, that vermicompost making should sustain itself as an income-generation activity; secondly, that it should contribute to sustainable farming locally. With this in view, the method as well as the functioning of the groups are regularly reviewed and improved. In the beginning of this activity, more than 70 percent of the material used was dry dung and the remainder was straw and dry litter. Some groups were using the same proportion of wet dung. It was recommended that no more than 40 percent dung be used, so that a larger proportion of straw and litter can be made into vermicompost. The aim is to maximize the recycling of waste biomass for increasing the biological fertility of soil.

Vermicompost making through self-help groups is a good example of BAIF's strategy. By combining technical interventions with community mobilization, BAIF tries to enable the rural poor to come out of poverty. ■

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Guinea pigs in ecological farming

Luis Gomero Osorio

HECOSAN is an ecologically managed farm, one hours drive from the Peruvian capital, Lima. Situated in a rural setting dominated by monocultures, it was started to challenge conventional agricultural systems – characterized by low agrobiodiversity and high levels of agricultural inputs – and to demonstrate that a different way of farming is possible. Now, four years after the start, the benefits of building an integrated, biodiversity-rich farm are becoming clear.

As an agronomist, I was concerned with the drawbacks of conventional high-input agriculture. For many years I discussed with colleagues and farmers about alternatives and promoted biological soil and pest management practices. In the year 2000, I decided to put my knowledge into practice by developing a production system based on agroecological principles, and characterized by the integration of crops and livestock and the recycling of resources produced on the farm. The result is HECOSAN, a 3.8 hectare family farm situated in the Chillón river valley at an altitude of 750 metres above sea level, in an area with a dry temperate climate, high levels of solar radiation, an average annual temperature of 24 °C and with annual rainfall of less than 100 mm per year.

Livestock

The farm has a number of different animals; a horse, two cows, poultry, sheep and guinea pigs (*Cavia porcellus*). Guinea pig meat is highly valued in Peru, because of its high protein content (18 percent) and suitability as food for children. The animals produce manure for the farm but they have other roles and uses as well. The horse is used as a draught animal, while the cows produce milk for the farm labourers. The cow's manure is an important component of the farm because it is used in the farm's biodigester that produces liquid fertilizer. The sheep (Hass Black breed) are kept in a stable and produce meat, mainly for the market. The free-ranging poultry help to reduce crop damage by feeding on insect pests. Maize grains complement the poultry's diet. Their eggs and meat are sold on the market.

About 80 percent of the manure produced on the farm is directly used for fertilizing the land. The remaining 20 percent is used for making vermicompost and liquid fertilizer. All types of manure produced on the farm can be used for the production of vermicompost (see article by Daniel on p 12). This is produced on the farm by the earthworm *Eisenia foetida*, and is spread on the land in order to enhance the quality of the soil in terms of structure and organic matter content. Cow dung is reserved for making liquid fertilizer in biodigesters because of its high concentration of microorganisms. These greatly enhance the fermentation process in the biodigester, leading to the production of high quality liquid fertilizer. This is applied to the foliage of the crops, boosting growth.

Crops

A number of annual crops are grown; alfalfa, forage maize, purple maize, peas and cowpea (*Vigna unguiculata*). The maize and the two leguminous crops (peas and cowpea) are grown under rotation. The leguminous crops improve soil fertility and the peas and cowpeas are consumed, with excess produce being sold. The cobs of purple maize are sold and used nationwide for making *chicha morada*, a popular drink. Forage maize is for use on the farm only and produces feed for all the animals. Alfalfa (*Medicago sativa*) is a very important farm component, because this leguminous forage crop is specifically grown as a feed source for the guinea pigs.

The farm is designed to use the available space as efficiently as possible. Native fruit trees, including avocado (*Persea americana*), *lucuma* (*Lucuma obovata*) and sweet granadilla (*Passiflora ligularis*) have been planted along the farm's borders. The fruits are sold on the market. Elephant grass (*Pennisetum purpureum*) has also been planted along the farm's border. This forage crop develops very well during the summer months, at a time when alfalfa's growth rate declines for climatic reasons. The strategy of simultaneously taking into account the dimensions of space and time, helps to ensure permanent availability of forage for the animals. Two more drought-resistant plants have been incorporated along the border, forming a productive fence: *tara* tree (*Caesalpinea tinctoria*) and prickly pear (*Opuntia ficus-indica*). Pods of the *tara* tree are sold for use in the tannery industry, while prickly pear fruits are for own consumption.

All the biomass on the farm is produced organically. Manure produced on the farm is complemented with *guano de islas*, a seabird excreta that is a rich source of minerals No agro-chemicals are used.

Guinea pig breeding

The breeding of guinea pigs is not complicated, but it is very important not to expose the animals to any type of stress, because this will suppress their immune system and increase mortality rates. Special attention should be given to providing the animals with a balanced diet and to keeping them in proper housing that protects them from sudden changes in temperature. Frequent cleaning of the sheds is also crucial.

Female guinea pigs are sexually mature after 4 to 5 months and males start reproducing at about 5 - 6 months of age. Animals for breeding purpose are kept in compartments of 1.2 m^2 of size, made of adobe bricks and mud. Each compartment houses ten breeding females and one male. After a gestation period of about 60 days a female gives birth to 2 - 4 young. The young are left with their mother for about three weeks and after that they are weaned, sexed and selected, mainly on size. The young animals are kept for three months in three-level cages constructed with eucalyptus wood, wire and zinc roof sheets, and after that period a second and final selection is made. The animals that performed best in terms of initial weight and weight increase are selected for breeding. They will replace the old breeding animals or will be sold for their favourable breeding traits. The other animals will be sold for their meat.

Starting with an initial stock of 300 straight-haired animals of Andean, Peruvian and Inti breeds (a classification related to the colour of the hair), HECOSAN now has an average annual population of 2500 guinea pigs, including 700 breeding males and females and 1800 animals for fattening. Every month around 250 animals are sold for meat at the market in Lima, fetching a price of US$2.40 each.

Guinea pig feed

The guinea pig feed mainly consists of alfalfa forage, which is the main source of protein, forage maize and elephant grass, which are good sources of carbohydrate. During summer there is sufficient biomass but in the winter period the growth of the forage plants slows down and the availability of feed is reduced.

1. Entrance
2. Watchman's hut
3. Shed for breeding Guinea-pigs
4. Conference room.
5. Shed for raising guinea-pigs for the market
6. Water tank.
7. Cattle corral.
8. Sheep and goat shed
9. Chicken and duck shed
10. Organic compost pile
11. Water reservoir
12. Avocado (Persea americana)
13. Lucuma fruit trees (Lucuma obovata)
14. Elephant grass (Pennisetum purpureum)
15. Sweet granadilla (Passiflora ligularis)
16. Maize 'choclo' (Zea mays)
17. Pepper trees (Schinus molle)
18. Maize 'morado' (Zea mays)
19. Irrigation channel
20. Tara (Caesalpina tinctoria)
21. Alfalfa (Medicago sativa)
22. Road

Plan of the HECOSAN ecological farm.

To complement the diet during this period, residues of quinoa, oats and wheat flour is bought and given to the guinea pigs. This feed supplement contains proteins, fibre as well as a balanced amount of minerals and vitamins. The animals grow well on this diet and stress due to nutritional factors is avoided.

Health management

Good health management is of critical importance in guinea pig production. In the beginning we were confronted with serious health problems leading to economic losses, but four years of work and research has enabled us to understand the causes and to develop a suitable integrated management of the animals.

The most important disease is salmonella, caused by bacteria, because of the potential damage it can cause. This microorganism is always present in the system and affects animals with a weakened immune system. To avoid this, good management is required to avoid stressing the animals in any way and the sheds have to be kept very clean.

Another problem in guinea pig keeping is the presence of ectoparasites. They are mainly a problem in the breeding houses, where the conditions are favourable for their multiplication. Severe parasite attack may lead to increased mortality, reduced growth rates and miscarriages. Many farmers use pesticides to control ectoparasites, but at our organically managed farm we had to search for alternatives. After two years of testing we found that the application of a plant extract (*Lonchocarpus* sp.) in combination with carbonic soap (normally used for disinfection) provide excellent control of these ectoparasites. The use of cages for keeping guinea pigs greatly reduces the problem of ectoparasites. These findings have helped us to avoid using pesticides and to solve the problem using a preventive approach and natural methods.

Benefits in the short and long term

As mentioned earlier, the raising of guinea pigs is the driving force of the system. They reproduce rapidly and their management is relatively uncomplicated. The farm generates sufficient income to provide work for two permanent labourers, who take care of the animals and handle all the other components of the system. At the beginning the labourers found it difficult to understand the concept of integrated farming, because their knowledge and experience was based on the conventional agriculture practised in the area, based on monocultures and usually lacking a livestock component.

Comparing HECOSAN with neighbouring farms there is a clear difference in the rate of capitalization of the land, in other words, the extent to which the land has been made useful and productive. At present HECOSAN has 2500 guinea pigs, 200 avocado trees, 100 *lucuma* trees and 20 producing granadilla plants. The farm also has 100 chickens, 30 ducks, 10 sheep, two heads of cattle and one horse. These farm components ensure a sustained economic income over time, help achieving food security and, through the process of nutrient recycling, enhance the stability of the system. The average monthly gross income of HECOSAN is almost US$900, a very acceptable figure given its small size. In comparison, local farmers who produce cotton in a conventional way obtain a gross monthly income of US$1024, but the cost of the external inputs that they use is high and no lasting value is added to their property.

■

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Improving the performance of indigenous sheep breeds

Bernardo Fulcrand Terrisse

In the semi-arid regions of the Andes, in Peru, Bolivia and northern Chile, ancient pastoral systems are part of daily life. In *Región Inka*, located on the eastern side of the Andes mountain range in Peru, sheep keeping is part of a traditional culture that is characterized by strong family ties and community structures. People live in *comunidades campesinas* or farm communities that have their own organization and are represented by elected community members. The communities own the land and are responsible for the management of common resources including land and water. Families are given access to land on a usufruct basis and all families have access to the communal pastures. Collective labour based on principles of reciprocity, cooperation and solidarity is the rule.

Being a mountainous region at tropical latitudes, *Región Inka* displays diverse landscapes at different altitudes. At altitudes of between 3000 and 4500 metres, there are two distinct eco-regions: the *Qheswa*, characterized by a temperate climate, where people grow crops such as maize, potatoes, broad beans and grain crops as well as keeping livestock, and the higher, colder *Puna* area, where people depend on extensive livestock keeping with sheep, alpacas or llamas. Indigenous breeds of sheep are the most important livestock component and they are usually taken care of by women and children, who accompany the herds on their grazing trips. Women are very attached to their sheep: *the sheep help in every way*, they say. Sheep provide a family with meat, wool and manure. The wool is used for the production of crafts (woven textiles, ponchos, etc.). The sheep provide money to the family in times of need, since they can be sold at any time of the year. Sales of meat, wool and crafts also provide an important source of income and help mitigate the risks involved in farming.

A perfect fit

Indigenous animal breeds are extremely valuable for millions of small-scale farmers worldwide. They often perform much better than "improved" breeds, because of their good adaptation to specific natural and social environments. This is also true for indigenous breeds of sheep in the Andes, which are very sturdy and resilient. They are adapted to climatic extremes because they possess a good thermoregulation capacity. The sheep also resist tiring walks over long distances and are adapted to the steep and irregular terrain. They have the capacity to survive periods of food shortage by using their body reserves, but once food supplies are available again they quickly recover their strength. Their foraging behaviour is very efficient and they are capable of finding sufficient grasses and herbs even in areas with sparse vegetation and their digestive systems are adapted to the different types of vegetation in the area. They are also resistant to infectious and parasitic diseases common in the area, such as *Fasciola hepatica*, and intestinal problems caused by worms.

Indigenous sheep have a good reproductive capacity, partly because females come into heat independently of the season. The females also have a well-developed maternal instinct and are easily milked and the animals' lifespan is long.

These excellent physical characteristics form the basis for their economic significance for the farmers. The sheep thrive in, and generate value from, the extensive marginal areas of the high Andes, with minimum use of external inputs. They make good use of harvest residues such as stubble, straw and dead leaves. Sheep raising is relatively uncomplicated, without much investment needed.

Attempts have been made to introduce "improved" sheep breeds (Corriedale or Hampshire Down) into the area, but without success. Predictably, the improved breeds were not adapted to local conditions, including the limited animal husbandry practices. In addition, the meat of improved breeds was not accepted, because it is much fattier and stronger tasting than the lean meat produced by indigenous sheep.

Recovering from neglect

In Peru indigenous livestock breeds have been consistently neglected at policy level and by field technicians. This is also true for indigenous breeds of sheep, even though they represent a major part of the total national livestock. This long-term neglect, expressed in the lack of research and extension programmes to improve animal husbandry practices for indigenous sheep, has led to a very low productivity per head. Within flocks the individual animals are often closely related to each other as a result of the absence of any conscious programme of selection and breeding. In addition, farmers have traditionally regarded their sheep as a savings bank rather than an animal for production purposes. They often sell the biggest animals, thereby creating a negative selection and reducing the quality of their flocks and their productivity.

However, this has started to change as different actors, including the farmers themselves, have become aware of the situation and have started to work on improving the indigenous breeds. One of these initiatives was started by the NGO *Asociación Arariwa del Cusco* and the association of indigenous sheep breeders *Asociación de Criadores de Ovinos Criollos* (ACOC). Together they identified three major work areas: selection and

Photo: Author

The breeding programme gives strong healthy lambs.

breeding of indigenous sheep; training of breeders; and access to niche markets. On this basis they developed a programme for the improvement of indigenous sheep in the *Qheswa* and *Puna* areas. While these two organizations are the driving force, other actors, such as the Agricultural University, the Ministry of Agriculture and other NGOs, have also become involved.

Breeding
There is a great, yet untapped, genetic production potential for indigenous sheep in the country, which is expressed through the high variation in milk capacity, live weight, and fertility observed in the country's sheep herds. The members of ACOC realized that it was necessary to set up an exchange system between different flocks for breeding animals. This would overcome the high level of close blood relationships within the flocks, which depresses productivity and increases the number of genetic defects. They established a number of criteria to guide the breeding programme and make it effective:

- Elimination of the most common genetic defects
- Selection within each flock of females based on milk production, live weight, fertility and total annual weight of lambs per female at the time of weaning;
- Selection of lambs for breeding purposes based on the increase in live weight, development and conformation.

Special care was taken in this selection process to avoid losing the traits of sturdiness of the indigenous breed.

Training
A second objective of the association is to provide education and training to the breeders, both women and men. Farmers need to change from "sheep owner" to "sheep breeder", something which does not happen overnight but requires a gradual process of awareness raising and improvement of knowledge and skills. This process needs to be facilitated by technicians who can collect and process information and feed it back to the breeders. The breeder needs to learn to perceive changes and to interpret them, and thereby improve his/her knowledge. It is a process whereby breeder and animal evolve hand in hand. The technician also provides guidance in the socio-cultural process of change in which husbandry practices are adapted and a relationship to the market is developed.

Marketing
Another objective of the ACOC is to obtain more benefits from markets by selling better quality products (animals for breeding purpose or meat) at a better price. Market access has been enhanced through participation in local and regional livestock fairs, where member farmers can offer good quality products and show that they are good breeders. At the same time the ACOC is trying to develop certain niche markets. The meat of indigenous sheep has several advantages over imported meat produced on industrial farms: it has a better taste, is produced in the region and can be sold as "ecologically produced".

Arariwa stays involved in ACOC's activities. It supplies a technician who monitors and assists the selection and breeding activities. *Arariwa* is also involved in the technical training of farmers, for example on animal health, feeds, general husbandry, and the NGO assists in the marketing programme.

Progress and plans

At present the ACOC represents a total of 132 breeders and the association makes use of 24 herds for selecting animals. During the past ten years of selective breeding the average birth weight of the lambs in these herds has increased from 2.5 kg to 3.9 kg, and the average weight of the ewes has increased from 29.7 kg to 37.3 kg. Daily weight increase in lambs has increased from 97 g per day to 123 g per day.

Table 1 shows some of the major traits of the six herds that have been in the programme for more than seven years.

Table 1. Important traits of six sheep herds at the end of 2004, after a seven-year selection period.

Characteristics	Average	Minimum	Maximum
Live weight adult ewe (kg)			
- Herd A (n = 25)	26.3	20.4	32.7
- Herd B (n = 46)	27.1	20.9	29.5
- Herd C (n = 55)	28.1	21.8	34.5
- Herd D (n = 47)	31.3	24.5	43.1
- Herd E (n = 26)	28.9	22.7	34.5
- Herd F (n = 56)	31.7	24.5	38.1
Age at time of first delivery (months)	20	11	30
Daily increase in live weight (in grams) of lambs in the 1th month after birth	119.5	42	232
Lambs that survived until weaning (%)	91.8	82.9	97.9
Live weight (kg) of female lambs at weaning time	13.73	11.8	17.3
Live weight (kg) of male lambs at weaning time	14.91	11.2	17.6
Ponderal productivity of ewes (kg)	8.26	4.32	13.7

Source: Programme for improvement of indigenous sheep breeds (Asoc. Arariwa)

Ten years of breeding through selection has led to an improvement of several production and fertility traits of indigenous sheep, an increase in the productivity of the flocks, and an improved income from selling slaughtered animals or animals for breeding purpose. Members of the ACOC have received training on aspects of breeding and on improved animal husbandry techniques related to feeding, reproduction and veterinary care. They are now in a better position to carry out further improvements in the management of their livestock, including proper selection and exchange of breeding animals, elimination of poorly producing animals, primary veterinary health care (parasite control and proper dosing of medicines).

A start has been made to access the niche market of "ecologically produced" meat for high-class restaurants and for the tourism industry. Much progress still needs to be made but ACOC and *Arariwa* feel that there is a lot of potential and that it is worth making the effort. Firstly, sheep meat has to become part of the gastronomical menu of the restaurants frequented by tourists. Another "bottleneck" is setting up a production chain that complies with the sanitary requirements of this market. This requires an adequately designed and equipped slaughterhouse that guarantees hygiene, appropriate slaughtering techniques and cutting of the meat, proper drying and conservation in a cold room, and efficient distribution and sale to the restaurants. Some advances have already been made: chefs of prestigious restaurants in the city of Cusco were provided with meat of lambs of three different ages. They found the meat to be excellent, and the restaurants have shown interest in helping to develop a production chain that meets the criteria of hygiene and efficiency. ■

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Photo: Author

Mama Prosper with her dairy goat, Kibosho, Tanzania.

Supporting families living with HIV/AIDS

Erwin Kinsey

Mama Prosper, the name of her eldest son, is the name by which Matilda is known among her neighbours in Kibosho, a densely populated ward of hillside villages in the foothills of Mt. Kilimanjaro, Tanzania. Until recently she and her husband Thadei worked together on their small farm, a one hectare parcel of land in the coffee and banana belt which skirts the south and eastern slopes of this great mountain. Their diversified farm was typical of those in the area, multiple layers of shading by indigenous *Albizzia* trees, bananas and coffee, grass hedgerows surrounding small plots of sweet potatoes, maize, finger millet, yams, and beans. It was an intensively cultivated smallholding in which by-products were fed to two zebu cattle, a few local meat goats and sheep, traditionally kept chickens, and pigeons, which in their turn added fertility. There was occasionally enough to sell but mostly just enough to subsist on and raise their family. They had five children and lived relatively happily together.

Thadei contracted HIV about six years ago. His life lingered for two years before he died in 2002. The cost of medical care for his treatment was a burden on the family; they sold most of their livestock. Now Matilda remains with her five children, 3 boys and 2 girls aged 7 to 16 years. As a widow she has found some comfort in her children and her in-laws, who have agreed to let her remain with some of their land and the house they had built, however losing her husband has changed her life immeasurably. Life for a widow with five children is a great challenge. Other in-laws in similar circumstances have pushed widows and their families out of the house and forced them back to the widow's parents. Matilda is grateful that she has been able to continue to live in the small family house she built with Thadei. Her eldest son is 16 and will soon be able to inherit the land through the patrilineal system of inheritance. But this is not enough for all of the family to live on. Matilda has needed to find new sources of income on their small farm.

She feared that she probably had also contracted HIV and was anxious about being tested. When her health began to diminish, she was told at the hospital that she suffers from tuberculosis, and for this she continues to seek treatment. However, she expects that she is indeed suffering from AIDS. The frequent trips down the mountain to the hospital tire her, she lives 8 kilometres away and sometimes they must hire transport. The financial burden is almost unbearable, about US$40 per month, although it has been shared by her wonderfully caring in-laws, her friends in the village and her church. By losing her husband her life became uncertain, but now it is filled with dread of dying before her children are old enough to care for themselves. The hardship and pain are evident on her face as she relates her story with difficulty – she lifts her *kanga* to her forehead to fight the tears. She rallies, boldly and beautifully, looks into your eyes with a steady glance. She shares her want, more than anything, to be able to support her children through their school years.

Matilda's story is very common in Tanzania. Respecting no social class, HIV/AIDS has already afflicted over two million Tanzanians. They reside in every community throughout the country - children, youth, single, married, elders, rich, poor, educated, uneducated, teachers, doctors, students, rural and urban. Few of the programmes that have been initiated to assist people like Matilda reach into the rural areas. It is difficult for health services to reach them, but reach them they must. NGOs like Heifer Tanzania can help these services reach them through their widely distributed network of project holders in rural areas. Yet health education and services are not enough. Apart from access to voluntary counselling, testing, anti-retroviral medicines and monitoring, people also need the means to improve their nutrition and maintain their immune status. Projects using small livestock, which do not have heavy requirements, bring rapid returns and provide many benefits.

In Heifer's experience dairy goats are an entry point to help bring about gender and social equity, and instil the principle of democracy and awareness of the importance of basic and environmental education. Project families are encouraged to revert to time-honoured methods of growing diverse crops, to intercrop rather than practice monoculture, and to plant trees for fruit, firewood, and shade. Where possible, they are encouraged to start to raise other types of small animals to spread risk and generate additional produce. More diversified farms allow a greater variety of produce to be available throughout the year. After receiving training, they build a goat shed and plant fodder trees and grasses, usually along contours, to protect soil and conserve water.

Families raise the goat under "zero grazing", conditions in a shed where it is less exposed to diseases and parasites. It does not waste energy going long distances for food and water. This practice also helps safeguard the environment by preventing uncontrolled browsing of trees. It also helps control random breeding so that the animals can remain of high genetic dairy potential.

Heifer Tanzania has distributed dairy goats since 1987 helping families with very limited resources, but these days the emphasis is on people living with HIV/AIDS. However, focusing projects on families living with HIV/AIDS is not so easy: because of the stigma attached to the disease it is difficult to identify the sufferers. Heifer Tanzania has only been able to focus its resources on poorer, more desperate, families such as Matilda's through engaging in new partnerships with health and social welfare specialists in local hospital and hospice care programmes. They are needed to identify the recipient families and to help engage their neighbours in safety nets to assure their success. Heifer supports HIV/AIDS affected families to improve their nutrition through three activities: dairy goats, chicken vaccinations and bio-intensive gardens.

Dairy goats

Matilda was one of ten women in the village to obtain a dairy goat as a means to mitigate the effect of AIDS, and thereby improve her and her family's nutrition. She received a dairy goat on 24 December, 2003, which she called Noel. 'I sent Prosper to the two-week training required before receiving Noel. We planted more fodder trees, and built this small goat shed to qualify for the loan. I love my goat; she gives me so much hope. She has been bred three times, and I am hoping this time she is pregnant.' Getting the goats pregnant is important in goat keeping, a key to success; families must be taught the common signs of heat or keep the buck with the doe throughout the three week cycle between heats. Poor goat nutrition also prevents successful breeding, so training emphasizes good feeding. While her neighbours' goats have already kidded (and have shared their milk with her) she hopes to have milk of her own and the much needed income from the sale of offspring soon.

Bio-intensive gardens

Families living with HIV/AIDS often lack the labour needed to cultivate their fields. The project therefore assists families to plant small bio-intensive gardens to ensure year-round availability of nutritious organic leafy vegetables. The manure from the goats is collected from the shed, composted, and used directly on the garden crops instead of being scattered all over the village as happens when goats roam free. Raised vegetable beds are established by digging beds of 3 to 4 square metres each to a depth of 60 cm and incorporating a high level of compost. Families are encouraged to recycle the used household water to irrigate the vegetables. This effort has increased the year-round availability of green-leaf vegetables. The raised vegetable beds permit intensive production and minimize the need for labour. With abundant green leafy vegetables available, the family is less vulnerable.

Poultry vaccinations

Introduction of an innovative technology and appropriate extension approach can have dramatic benefits. Traditional poultry keeping is the most common of all livestock keeping in rural Tanzania – there is hardly a household which has not kept chickens, and thus their number is equivalent to the Tanzanian population of 36 million. Chickens are owned by the poorest members of society, and are the easiest source of income and food security for marginalized groups. Chickens are commonly free ranged, scavenge for their food, and demand few requirements. However, they suffer from annual losses of up to 70 percent mainly related to Newcastle Disease! The lack of rural veterinary services and inputs contributes to such high losses. This is a national disaster which up until recently has gone relatively unnoticed because chickens are usually the property of women and youth, and an appropriate technology had not been developed to prevent it in the vast rural areas.

In 2002 Heifer Tanzania began a pilot project to distribute improved poultry to youth to enable them to raise school fees to continue their schooling. However it was through the Newcastle Disease vaccination efforts done in preparation for the distribution that it was realized disease prevention is much more important than distributing poultry. A new vaccine (I-2) has recently been developed which is heat stable – allowing it to be used in remote areas – and sold in small quantities. These two constraints have earlier hindered vaccine campaigns against Newcastle Disease (ND). The vaccine is also advantageous in that it is locally produced and easy to administer as eye-drops. Vaccination reduced losses significantly in the pilot areas. The reduction in losses of local chickens meant increased incomes, a source of protein (eggs and meat) for home consumption, especially for children and mothers, besides providing for traditional uses of social value. Thus the indirect impact on families with HIV/AIDS was enormous. Increased survival of chickens means also an increased rural employment, especially of youth.

Heifer Tanzania has now changed the approach it had started on poultry; instead of emphasizing distribution of chickens, it will now focus on ND vaccinations. Training of farmers and village vaccinators is the key, as well as ensuring linkages for vaccine provision and monitoring.

Lessons learned

While the intention of the project support is to assist in practical ways, sometimes the benefits of the assistance are not as immediate as the need. A goat and a garden do not provide a complete solution. In one village, people had organized themselves into small cluster groups of four families that were supporting each other. The project thrived as one goat was given on contract to each cluster, and the offspring were circulated among the cluster until all families had goats. This functioned so well that Heifer tried to incorporate this idea to provide safety nets to families with HIV/AIDS. However, it has proved difficult to promote the idea; while some groups function, others do not. This mobilization needs to come from the community itself: from the bottom up. It is difficult to understand all the dynamics involved in those groups that do function. Heifer would prefer to work with already established natural groupings than to create its own groups, but there is a tension – how then can the poorest be reached: those who are not already part of an existing group? Heifer's project holders must often work at the entry-level on strengthening groups.

Heifer's efforts are really more about helping people than about livestock, seeking ways to alleviate the poverty and related suffering of families and to stimulate social welfare within the communities. Livestock are used as catalysts to help them to improve their livelihoods by practicing better farming techniques and obtaining improved production but also to be able to better handle their livelihoods in general. All our work requires learning, especially as we seek to help those most vulnerable such as people who live with HIV/AIDS. ■

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Organizing production of village chickens for the market

Michael Zoebisch and Theerachai Haitook

Pong Chanuan village is located in the western upper reaches of the Lam Phra Phloeng watershed, Nakhon Ratchasima Province, north eastern Thailand, and borders the Khao Yai National Park. The area is generally hilly with only a few flat areas near the river courses. The village was founded in 1949 by three families, who came from the forest area that later became the National Park. During the 1960s and 1970s large numbers of landless people from other parts of the province settled in the village. They clear-cut patches of government forest for upland rice, cotton, peas, beans, and vegetables for home consumption. The development of agriculture in the area was very slow at that time. However, due to the increasing population (mainly from in-migration), more land was cleared to grow crops and large parts of the natural forest gradually deteriorated. The development of a simple dirt-road network opened market opportunities and encouraged the farmers to produce crops for sale. Upland rice for home consumption – a highly labour-demanding crop – was increasingly replaced with maize that could be sold to feed mills, and oil-extraction and starch factories.

Around 1970, maize had become the overwhelmingly dominant crop in the area and the farmers now depend almost exclusively on maize. Over the years, the monocropping of maize has led to a loss of soil fertility and the farmers have to apply more inputs to maintain high yields. This creates increased requirements for cash to buy inputs.

Photo: M. Zoebisch

One of the farmers in the network shows one of her local chickens.

The changes in land use also brought along changes in crop and land husbandry practices. More intensive cultivation of larger areas led to a higher degree in mechanization, especially soil tillage. Expectations for higher crop productivity led to the introduction of hybrid maize varieties together with chemical (commercial) fertilizers and pesticides. These developments again increased the level of inputs needed to produce a crop. Thus investment costs increased beyond the capacity of most farmers leading to an increasing lack of savings and a continuous need for credit.

Almost all the agricultural land belongs to the government, and without full land ownership the farmers cannot use their land as security in order to get loans from the agricultural or cooperative banks. As most small farmers depend on credit to grow their crops, they face significant difficulty in obtaining the capital needed for inputs (e.g., machinery hire, seeds, fertilizers, pesticides). They therefore have to borrow from private money-lenders with interest rates of around 5 percent per month (i.e., 60 percent per year). This means that most farmers have debts, only about 10 percent of the farmers are debt free, and about 50 percent have debts of more than 50 000 Thai Baht (US$1 220). The smallest farmers are the most heavily indebted. In most cases, the moneylenders are also the middlemen who provide the inputs on loan and who take back the produce after harvest.

The farmers, therefore, have no control over the sale of their produce. They have to deliver their harvest to the creditors to pay back their loans “in kind”. The moneylenders also determine the price for the produce, taking advantage of the high interest rates as well as the low prices of the crops immediately after harvest. This creates a permanent dependency on the moneylenders and the farmers effectively become contract workers for the creditors, leaving them hardly any profit and virtually no room for long-term investment in the development of their farms.

The farmers are aware that, in the long term, the fertility of their soils will decrease because of the lack of soil-fertility maintenance measures and inappropriate soil-tillage practices that enhance soil degradation and erosion. They are aware of the need for improvements but are not in a position to make investments beyond what is required to produce the next crop. There is little prospect in the short term for effective changes in the general economic and institutional frameworks within which the farmers operate. Their options are therefore limited to measures that economize inputs and changes in practices that do not require additional investments (of either labour or cash).

This does leave an opportunity for the integration of small animals, such as chickens, which can provide a small extra income without the need for external inputs. Maize and other farm produce and crop residues can be used as feed and their manure can also help to improve soil fertility.

A farmer group initiative

Five farmers in Pong Chanuan village took the initiative and set up a small network for fattening local chickens in the village. With assistance from the Asian Institute of Technology (AIT), the farmers had identified local chickens as an untapped niche market in the district and provincial capitals. Fattening the chickens is straightforward as the farmers can use their own feed

resources, mainly broken maize, mungbean, vegetable leftovers and small amounts of dried fish and herbs, the latter of which they collect from around their homesteads. Local traders have agreed to purchase the chickens, provided the farmers can ensure a regular and reliable supply of birds of a marketable-size - and this is the major bottleneck. In a typical small-farm scenario, individual farmers will have difficulty in ensuring continuous production of a sufficient number of chicks at predetermined times. Therefore, the farmers in Pong Chanuan joined hands. They started an informal village network in order to supply each other with fertilized eggs from their breeding stock. This would mean that the fattening of the chickens could be co-ordinated, but it also meant the farmers stopped consuming and selling eggs individually. The aim of the group is therefore to coordinate and streamline the production of local chickens from within the village, from the collection of eggs for hatching to the slaughtering of the birds for sale in batches.

As day-old local chicks are not available from commercial breeders, the farmers have to produce their own supply of chicks from fertilized eggs. Hatchability of the eggs is not a problem, but the number of eggs per hen is rather low and local chickens do not lay eggs continuously, but tend to produce eggs in clutches; typically 2 to 4 clutches per year with a total number of between 30 - 92 eggs. This requires that enough hens – and cocks – are kept as reproductive stock to provide a year round supply of enough chicks. It also requires the introduction of simple incubators to reduce the relatively high losses that normally occur with natural hatching, and to ensure that sufficient numbers of chicks hatch simultaneously.

The setting up of producer networks requires careful planning. The two most important factors are the number of slaughter chickens to be sold and the capacity to produce enough day-old chicks for fattening. To secure the supply of fertilized eggs for hatching, each participating farmer maintains her/his own breeding stock. The five farmers of the group each keep one flock of breeder chickens (10 females and 1 male). The animals are kept in simple shaded pens with resting perches and laying nests. The fertilized eggs are collected daily, delivered to the hatchery and stored for hatching.

Hatching is done in batches of about 50 eggs per week with a simple electrical-bulb-incubator controlled by a thermostat, with a capacity of 200 eggs. One member of the group operates the incubator (i.e. the hatchery) and plays a key role in supplying the day-old chicks to members of the group. Because of the irregular egg-laying habits of local chickens, the group members pool the eggs from their breeding flocks so that there is a constant supply of enough eggs to supply chicks for the fattening flocks. This is essential in order to achieve a regular supply of slaughter chickens to the market.

The hatchery produces and distributes the chicks to the group members according to an agreed schedule. Each member has to supply at least enough fertilized eggs to the hatchery to meet at least his own needs for chicks. The members do not necessarily receive chicks hatched from their own supply of eggs.

The relatively slow growth of local chickens – compared to commercial hybrids – means that the production scheme can be more elastic. If need arises, the chickens can be either sold earlier or their sale can be delayed by a few days or even weeks without major changes in weight and condition. This provides some flexibility compared to commercial hybrids, for which a strict adherence to pre-determined production schedules is more critical.

Local chickens or hybrids?

There is a growing domestic demand for local chickens in Thailand, especially in the urban centres. Consumers are increasingly willing to pay higher prices for high-quality food and local chicken meat is preferred because of its better taste and firmer texture, which suits the traditional dishes. However, most of the chicken meat on the market is from hybrid (broiler) chickens produced by large companies and contract farmers. The price per kilo of local chicken meat is about 5 - 15 Baht (US$0.12 - 0.37) higher than for commercially produced broiler meat. Broiler chickens reach the marketable live weight of 1.2 - 1.4 kg after 7 - 12 weeks, whereas native chickens need 16 weeks to reach the same weight. Even with the use of commercial feed, native chickens have significantly slower weight gains than improved breeds.

However, the local chicken is not widely available on the market and demand exceeds supply. Local chickens present a typical "niche" market that is not attractive to large agribusinesses, which prefer to target the mass consumer market. This creates an opportunity for small farmers to increase their income. Improving the efficiency of local chicken production could therefore benefit large numbers of small farmers in the country.

Most small farmers in Thailand raise local chickens, almost exclusively for home consumption. Typically, a family keeps around 10 - 20 birds. The animals are allowed to scavenge during the day; and are only confined at night, usually under the farmhouse or in simple sheds. The feed consists of local materials, such as broken rice, bran, fruits, kitchen leftovers, grasses, weeds and occasionally insects, earthworms, aquatic snails, crabs and small fish. Local chickens are well adapted to the conditions of typical small farmers. Their tolerance of the hot climate and their resistance to diseases is considerably higher than that of high-performance breeds. It is therefore widely accepted that the raising of indigenous chickens has a high potential for rural areas, although the weight gains, compared to commercial breeds, are low.

The network has operated since 2004. There have been a few setbacks, mainly related to electricity failures that affected hatching of the eggs. The network has created strong interdependencies between the farmers and their growing mutual trust has been the main factor that has kept the group working despite the setbacks.

Conclusions

This community-driven small-scale farm enterprise provides a small, but reliable, additional income using on-farm resources, and employing ecological principles of farming. The network is characterized by a high degree of interdependency in the form of resource and risk sharing. Only farmer groups that have a high degree mutual trust in each other can succeed with an enterprise of this nature. A positive side effect of this informal cooperation was that the existence of the farmer group proved to be a strong bargaining partner for the middlemen, who have access to the urban markets. Their ability to provide a reliable supply of local chickens is a key in strengthening their future bargaining position with the middlemen.

A weak point of the network is the incubator. Even with rare electricity failures, the possible losses can be significant. The insulation of the incubator needs to be improved to bridge short periods without electricity for heating. ■

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Chicken-bamboo farming in Southern China

Lu Jianbo, Zhao Xingzheng and Wang Daoze

Agroforestry systems are being promoted in many developing countries as they provide timber, poles for construction, and fuel wood, while at the same time they have the potential to protect the soil from erosion and improve its fertility. However, many agroforestry systems are very much focused on the vegetative component, excluding the potential interaction with livestock and the interests of the farmer. This article describes a recently developed agroforestry system with an animal component, situated in a hilly region of Southern China. The system is analysed and the economic, social and ecological benefits are highlighted.

Photo: L. Jianbo

In the chicken-bamboo system the chickens are allowed to roam freely during part of the day.

Integrating forestry and livestock

Large parts of the hilly areas in Southern China are planted with bamboo forests. These forests help to enhance soil and water conservation and provide economic benefits from the sale of bamboo poles and edible bamboo shoots. Many farmers in Southern China own chickens and they usually let the animals roam in the open, for example in vegetable gardens, orchards, and grasslands. Usually farmers keep only small numbers of chickens. Recently the demand for chicken meat from free-roaming animals has increased and market prices have risen. This has provided the farmers with an incentive to increase the number of chickens and try to raise them in the forest areas. Interested farmers received assistance from scientists in technical matters, e.g. breed selection and disease control and together they made a plan of action, which resulted in an innovative system that combines chicken rearing with bamboo growing. Together with interested farmers, scientists of the Agro-Ecology Institute of Zhejiang University and the Agricultural Bureau of Chunan county, Zhejiang Province, have set up a small number of pilot farms to study the chicken-bamboo system and develop it further.

One of the pilot farms belongs to Mr Hong Zhiwen, who was contacted through a local agricultural extension office. His bamboo farm is located in a watershed in Zhejiang province, an area with a semi-humid sub-tropical climate, with an average annual temperature of 17 °C, mean annual rainfall of 1430 mm, and an average relative humidity of 75 percent. His farm, about 1.7 ha, is covered mainly with redsheath bamboo (*Phyllostachys incarnate*), early garden bamboo (*Phyllostachys propinqua*) and Mao bamboo (*Phyllostachys heterocyda*). In 2000 Mr Hong obtained a bank loan to purchase chickens, and at present he owns about 20 groups of 300 - 500 chickens each, which are allowed to roam in turns in the bamboo forest.

Building and managing the system

Before buying the chickens, Mr Hong built four poultry houses on his farm, each with a size of 200 m^2, and situated in a quiet, well-aerated area protected from wind, rain and predators. When constructing the poultry houses, care was taken to keep them simple and cheap. The 1.8-metre walls were built with soil or bamboo, and the roofs covered with couch grass. The floors of the poultry houses were raised and made of bamboo rods that facilitate easy management. Newly-hatched chicks were bought and allowed to range freely in the field when they reached 25 days of age in summer, 40 days in spring and autumn, and about 50 days in winter. The chickens are divided in groups and allowed to range in turns. This is done to avoid overcrowding, which can damage the ground cover and cause soil erosion. Special care is taken not to expose chickens to rapid weather fluctuations which may cause sickness. Very hot conditions during summer are also avoided by releasing the chickens in the early morning. Mr Hong feeds his chickens twice a day, providing them with a ration of maize grains, paddy and soybean before their discharge in the morning and another in the evening. When they are in the bamboo forest, the chickens feed on grass, weeds, insects and earthworms.

Mr Hong has not made major changes in the management of his bamboo plants since he introduced the chickens. He keeps his bamboo in good health and maintains a density of 1.5 - 3 bamboo plants per square metre. However, as part of the chicken-bamboo agroforestry system, Mr Hong introduced specific forage crops which are randomly planted in the bamboo forest. They include clover (*Trifolium* spp.), alfalfa (*Medicago sativa*) and a number of cruciferous plant species (belonging to the cabbage and mustard family). He also decided to carry out soil and water management practices by planting along contour lines, establishing vegetation along the stream to retain the soil and building a dam to obtain a water reservoir.

The animal and plant components in the system are complementary. The chickens feed on insects, weeds, grasses and forage crops. Chicken excreta are directly deposited in the forest, making the soil more fertile which benefits the plants in the system. The bamboo and the vegetation cover supplied by the clover, alfalfa and cruciferous plants enhance the conservation of the soil and contribute to water conservation.

Table 1. Inputs and outputs of the chicken-bamboo farm during 2000 - 2002 (US$/ha)

	2000	2001	2002
Basic input			
- Poultry house	740	740	370
- Land preparation	990	494	
Bamboo input			
- Labour	49	74	99
Chicken input			
- Young chicks	990	2175	2965
- Feed	4942	10873	14827
- Labour	1483	1483	1483
Total input	9194	15839	19744
Outputs			
- Bamboo	670	1074	1236
- Chicken	10503	23106	31508
Total outputs	11173	24180	32744
Net outputs	1979	8341	13000
Benefit/cost ratio	1.21	1.53	1.66

The cost of the forage crop inputs are negligible; costs of health care of chickens (vaccines) are included in cost of young chicks.

Analysis of the system

The design of the chicken-bamboo farming system leads to a complementary and multi-level utilization of resources. The system produces bamboo, bamboo shoots and chicken meat, while improving or maintaining the soil fertility and preventing water and soil erosion, thus achieving significant social, economic and ecological benefits.

Economic benefits

The average annual income from bamboo grown with minimal management before the introduction of the chickens was estimated to be less than 10 000 Chinese Yuan per hectare (approximately US$1 240). Table 1 shows that the net income obtained from the chicken-bamboo farm is well above the income from the production of bamboo before the introduction of the chickens. It also shows an increasing trend over three consecutive years. The output/input ratio also increased during the period. The net income per chicken was calculated to be approximately US$0.70.

Ecological benefits

Animal and plant production systems that were originally separate have been integrated in the chicken - bamboo system, allowing for better nutrient recycling. The chicken excreta enriches the soil of the bamboo plantation. The chickens also loosen up the soil surface while searching for food. This enhances the decomposition of organic matter and increases the amount of available nutrients in the soil. Soil analysis showed that the content of nitrogen, phosphorus and potassium significantly increased, even though no fertilizers have been used. The analysis also showed that the organic matter content of the soil increased by approximately 70 percent, while the number of earthworms is now more than three times greater than before chickens were introduced into the system. Total earthworm mass also increased (Table 2). Soil erosion is kept in control because of the soil conservation measures that have been taken.

Social benefits

By introducing an animal component into the bamboo forest system the land is used more efficiently, allowing farmers to harvest plant and animal products from the same land. Since the animal and plant components are complementary they also produce better as compared to systems based only on bamboo or chickens. The system is more intensive and requires continuous and higher labour inputs during the whole year. This is a positive development because it allows for increasing employment opportunities for growing numbers of unemployed people in the rural areas. At present, the diets of those living in China's countryside are still lacking in animal protein, and the quality of the available meat may be low because of poor treatment of the animals. Breeding chickens in the bamboo forest increases the availability of good quality meat. The chickens roam freely and receive nutritious feed supplements consisting of a variety of grains.

Conclusion

This experience shows that small animals can be successfully introduced into agroforestry systems and that there are many advantages to this. Farmers can reap substantial economic benefits that will be a very important incentive to adopt such systems. The chicken-bamboo system is feasible for big and small-scale farmers alike.

The chicken-bamboo system is evolving and there is room for improvements. One of the components worth studying is earthworms. Active breeding of earthworms to develop a chicken-bamboo-forage-earthworm system might carry additional ecological and economic benefits, but this practice needs to be studied in detail. There should be active involvement of the farmers when developing such technological innovations and improved production systems in order to guarantee that they correspond to the farmers' needs.

Continued institutional support of farmers is required to achieve wider implementation of the chicken-bamboo system. One area which requires attention is the development of an efficient marketing system for chicken meat. Market demand for chicken meat exists, but farmers face difficulties in selling their produce. The support of local governments and farmer organizations is required to improve this situation.

■

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Table 2. Comparison of soil characteristics before and after the introduction of the chicken-bamboo system

	Sample depth (cm)	Organic matter (%)	Total nitrogen (%)	Total phosphorus (%)	Total potassium (%)	Amount of earthworms (worms/m²)	Earthworm mass (g/m²)
1999	0-15	1.54	0.122	0.067	0.95	88.9	71.93
2002	0-15	2.62	0.171	0.129	1.92	279.7	187.37

A local plant for de-worming goats

Czech Conroy and Y. A. Thakur

Goat keepers in Dharwad district, Karnataka, India, are mainly marginal farmers and landless people, and many have only recently taken up goat-keeping. When researchers from BAIF *Development Research Foundation* (India) and the *Natural Resources Institute* (UK) visited the area to identify constraints in goat production, the goat keepers identified high kid mortality during the rainy season as their main problem. The researchers suspected that the kid mortality was linked to the worm burden of the does at that time of the year. The goat keepers did not practice de-worming and most were not aware of the presence of gastro-intestinal parasites in their animals. The project conducted trials in three villages in 2000 and 2001 to address this. It worked closely with goat keepers in these villages, who made their animals available for use in the trials, which were conducted *in situ*. However, winning the trust of the goat keepers was a challenge, because they were concerned that giving anthelmintic drugs to does in late pregnancy might result in them aborting. BAIF staff therefore selected Fenbendazole, a drug that was considered to be the least likely to cause abortion. A second treatment in the trials was the use of trichomes (hairs growing on pods) from *Mucuna pruriens*, a leguminous creeper present in the area. Researchers knew that members of a caste of people specializing in buffalo keeping, who lived about 70 km away, used it to de-worm their buffaloes. The researchers brought one of the buffalo keepers to one of the goat keepers' villages to discuss the technology with them, and to show them how to use a knife to remove the trichomes from the pods without getting very itchy fingers.

A participatory approach was used throughout. Treatments and doses were determined jointly with the goat keepers.
The goat keepers contributed half of the cost of the Fenbendazole, and the project the other half. Twenty-one farmers participated in the trial in 2000, which included two groups: 34 does receiving Fenbendazole 15 - 30 days before kidding, and 34 does without any treatment. The 2001 trial included three groups: 26 does receiving Fenbendazole, 26 does receiving the *Mucuna* treatment and 26 control animals. A total of 18 farmers participated. In the first trial kid mortality was recorded over the first two months after birth, and in the second trial this was extended to four months. During Trial 2, goat droppings from 20 pregnant does were collected (immediately prior to treatment and seven days after) and analysed to determine the parasitic burden.

Results

In the first trial kid mortality was lower in the de-wormed group (about 8%) than in the control group (about 24%), but the difference was not statistically significant. In Trial 2, there was no significant difference in mortality between the kids of the control and dosed groups at up to 30 days, but the mortality of kids 30 - 120 days after birth was significantly higher in the control group than amongst the treated does (see Table 1).

Reduced mortality was not the only benefit produced by de-worming. The growth rates in Trial 2 were significantly faster for kids in the two treatment groups than for those in the control group. There is also evidence that does in the treatment groups conceived again sooner than those in the control group (i.e. they had a shorter kidding interval).

The numbers of parasite eggs in the goat droppings were significantly lower on the 7th day after de-worming in both of the treatment groups, whereas the egg numbers in the goat droppings of the control group increased significantly.

Conclusions

The data strongly suggests that the *Mucuna pruriens*-based treatment is as effective against gastro-intestinal parasites (helminths) in pregnant does as the commercial anthelmintic medicine Fenbendazole. Goat keepers have a preference for this treatment, because it does not need to be purchased and is widely available in the project area. All the goat keepers who participated in the trials are now using the *Mucuna* treatment, and some other goat keepers in the project villages have adopted this technology as well. Where *Mucuna* is not available some people who had previously not de-wormed their goats have started using Fenbendazole. This indicates the farmers' preparedness to carry out de-worming and, if need be, to pay for a de-worming treatment.

Since the technology is also used by buffalo keepers, it appears to be effective in de-worming large ruminants too. The technology could be useful in other parts of India and other parts of the world where *M. pruriens* grows wild, including Mexico, the Caribbean and Nigeria. In addition, *M. pruriens* is promoted as a cover crop and/or fodder crop in many countries. However, a different (non-itchy) variety is used, and research is needed to establish if this variety also possesses anthelmintic properties. ■

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References

- Anonymous 2002. **Deworming for improving the productivity in goats.** Technical Bulletin 2/2002, 7 pp. Natural Resources Institute and BAIF Development Research Foundation.
- Conroy C., Thakur Y. A. 2002. **Increasing the productivity of indigenous goat production systems through participatory research in ethno-veterinary medicine: a case study from India**. In: Proceedings of international conference on Responding to the Increasing Global Demand for Animal Products, 12-15 November, 2002, Merida, Mexico. pp. 67-68.
- Conroy C., Thakur Y., Vadher, M. 2002. **The efficacy of participatory development of technologies: experiences with resource-poor goat keepers in India**. Livestock Research for Rural Development. 14 (3).
- Peacock C. 1996. **Improving goat production in the tropics: a manual for development workers**. Oxfam, Oxford, England.

Table 1. Mortality of kids from birth to four months of age, Trial 2

	No. of kids born	No. of kids died			Mortality rate (%)
		1-30 days	31-120 days	Total	
Control	35	3	11	14	40.0
T1 (Mucuna)	31	3	2	5	16.1
T2 (Fenbendazole)	30	2	4	6	20.0

Improving egg management

Czech Conroy, Nick Sparks, Dinesh Shindey and L.R. Singh

There has been relatively little research in India on "village chickens"; on local practices, constraints and affordable technological improvements suited to small-scale chicken keeping. A research project, managed by the Scottish Agricultural College and with socio-economic inputs from the Natural Resources Institute and fieldwork by BAIF Development Research Foundation, has been making a modest contribution to filling the research gap.

The project, which began in late 2000, has been investigating the production problems facing poultry keepers in Udaipur district, Rajasthan and in Trichy district of Tamil Nadu, two semi-arid locations in rural India, and has been working with poultry-keepers to address some of them. A baseline survey identified serious problems with hatchability and mortality rates. In both districts egg spoilage was the single most important loss factor, followed by predation and disease, respectively.

In the three Udaipur project villages 25 - 30 percent of the eggs laid failed to produce chicks, while in the Trichy village the figure was just below 20 percent. This could be due to: the eggs not being fertilized; the embryo dying during embryo development; or the egg being contaminated with bacteria. In principle, eggs that are sterile, or in which the embryo has died before the egg is incubated, can be consumed or sold. But villagers were unable to distinguish them from fertilized eggs, so they would incubate all the eggs, thereby losing the opportunity to sell or eat the infertile eggs that were not going to hatch.

A method for improving egg utilization

Candling, the shining of a bright light through the shell, allows the stage of embryo development to be estimated, and thereby enables eggs that will not produce a viable embryo to be removed early on in the incubation period (4 - 7 days), and consumed or sold. Candling is widely used in the poultry industry, but the concept was new to the villagers. The only equipment that is essential to candle eggs is a good light source and a darkened area in which the eggs can be assessed. The project developed and tested a cheap battery-operated candling technology that was made from locally available materials (torch and metal box). Training in identifying infertile and fertile eggs using this technology was provided to four young males from poultry-keeping families in Udaipur in 2002 - 2003. A small trial was set up to check whether the trained farmers were able to distinguish between fertile and infertile eggs and this proved to be the case.

Improving hatchability of fertile eggs in the hot season

During the summer months (March - June) temperatures in Udaipur can reach more than 40 °C and poultry-keepers reported that during this period the percentage of spoiled eggs increased. It is well known that temperatures above 27 °C can increase embryo mortality rates, making it plausible that high temperatures are the cause of poor hatchability. The project team therefore tested another simple technology based on locally available materials that had the potential to reduce and stabilize the temperature of the eggs.

The technology involves the use of a half-moon shaped bowl, in which the eggs are kept cool by evaporative cooling. The bowl is filled with an earth/sand mixture that is kept moistened with water. A piece of jute bag is placed on the sand to prevent the eggs coming into direct contact with water. The eggs are placed on the bag and a cotton cloth or woven basket is placed over them. The bowl is placed either on a shelf or ledge or on the floor, inside a family building. When the hen stops laying, all the eggs are placed under her, as per existing traditional practice.

With the help of two groups of poultry keepers trials were carried out in 2003 and 2004, comparing a treatment using the cooled egg storage technology with a control group applying normal storage conditions. The percentages of fertile eggs that hatched viable chicks were about 69 percent for the control groups in both trials, compared with at least 84 percent in the treatment groups. The results provide clear evidence that the modified storage of eggs did improve the overall hatchability of the eggs.

The cooling technology underwent gradual adjustments. During the first trial clay pots were used but these had a tendency to crack, so it was decided to use locally available iron pots in the second trial. Although the latter proved to be effective, reed baskets lined with cloth have been used more recently. These baskets are cheaper and they have the advantage that evaporation may also occur through the side of the basket, leading to greater cooling.

Increasing outreach and awareness

Villagers recognize the value of candling, and one of the trained youths has set up a candling service for people in his village and neighbouring villages. However, the project's aim is to promote candling by each individual family, and a large-scale promotion programme is currently going on.

Candling of eggs is relevant in any poultry-keeping system in any country. The egg cooling technology is relevant in countries or locations that experience temperatures above about 30 °C at certain times of the year. Both technologies may need to be modified in accordance with locally available materials and circumstances.

The project has now entered its final phase, in which the focus is on dissemination of information about these two egg technologies and about prevention of mortality by predators, for example, by placing thorny branches in the yard for chicks to run under for protection if they are threatened by crows. Posters on these subjects are being distributed to 300 - 400 villages in four districts of south Rajasthan, and the BAIF staff responsible for livestock development in these villages are being trained in the use of the technologies so that they in turn can train the villagers. Similar activities are also being undertaken by two new NGO partners Seva Mandir and Livestock Improvement Federation (LIFE). In addition, the use of Farmer Poultry Schools (based on the Farmer Field School approach) is being piloted and evaluated in 4 villages of south Rajasthan and 2 in Tamil Nadu, working with existing women's self-help groups. Finally, the project is seeking to raise the awareness of senior government policy-makers and politicians in Rajasthan and Tamil Nadu of the importance of backyard poultry as a livelihood activity of the rural poor, and of the potential for enhancing its contribution to livelihoods. ■

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Azolla: a sustainable feed for livestock

P. Kamalasanana Pillai, S. Premalatha and S. Rajamony

The demand for milk and meat in India is creating new potential in the profitability of animal husbandry as an occupation. Yet, at the same time, there is a substantial decline in fodder availability. The area under forest and grasslands is decreasing as is the amount of various crop residues available for feed, largely due to the introduction of high yielding dwarf varieties. The shortage of fodder is therefore compensated with commercial feed, resulting in increased costs in meat and milk production. Moreover, as commercial feed is mixed with urea and other artificial milk boosters, it has a negative effect on the quality of milk and the health of the livestock.

The search for alternatives to concentrates led us to a wonderful plant *azolla*, which holds the promise of providing a sustainable feed for livestock. Azolla is a floating fern and belongs to the family of Azollaceae. Azolla hosts a symbiotic blue green algae, *Anabaena azollae,* which is responsible for the fixation and assimilation of atmospheric nitrogen. Azolla, in turn, provides the carbon source and favourable environment for the growth and development of the algae. It is this unique symbiotic relationship that makes azolla, a wonderful plant with high protein content.

Nutrient content and its impact on growth

Azolla is very rich in proteins, essential amino acids, vitamins (vitamin A, vitamin B12 and Beta- Carotene), growth promoter intermediaries and minerals like calcium, phosphorous, potassium, ferrous, copper, magnesium etc. On a dry weight basis, it contains 25 - 35 percent protein, 10 - 15 percent minerals and 7 - 10 percent of amino acids, bio-active substances and bio-polymers. The carbohydrate and fat content of azolla is very low. Its nutrient composition makes it a highly efficient and effective feed for livestock (see Table 1). Livestock easily digest it, owing to its high protein and low lignin content, and they quickly grow accustomed to it. Moreover it is easy and economic to grow.

Table 1. Comparison of biomass and protein content of azolla with different fodder species (t/ha)

	Annual production of biomass	Dry matter content	Protein content
Hybrid napier	250	50	4
Lucerne	80	16	3.2
Cowpea	35	7	1.4
Sorghum	40	3.2	0.6
Azolla	730	56	20

The Natural Resources Development Project (NARDEP), Vivekananda Kendra, carried out trials in Tamil Nadu and Kerala using azolla as a feed substitute. The trials on dairy animals showed an overall increase of milk yield of about 15 percent when 1.5 - 2 kg of azolla per day was combined with regular feed. The increase in the quantity of the milk produced

Close-up view of an azolla plant. The size of the plants are 1 - 3 cm.

was higher than could be expected based on the nutrient content of azolla alone. Hence, it is assumed that it is not only the nutrients, but also other components, like carotinoids, bio-polymers, probiotics etc., that contribute to the overall increase in the production of milk. Feeding azolla to poultry improves the weight of broiler chickens and increases the egg production of layers. Azolla can also be fed to sheep, goats, pigs and rabbits. In China, cultivation of azolla along with paddy and fish is said to have increased the rice production by 20 percent and fish production by 30 percent.

Azolla production

NARDEP has been working on azolla for the last three to four years, studying its potential as a feed and exploring cost effective methods for the mass multiplication of azolla in farmers' homesteads.

In our method, a water body is made, preferably under the shade of a tree, with the help of a silpauline sheet. Silpauline is a polythene tarpaulin which is resistant to the ultra violet radiation in sunlight. A pit of 2 x 2 x 0.2 m is dug as a first step. All corners of the pit should be at the same level so that a uniform water level can be maintained. The pit is covered with plastic gunnies to prevent the roots of the nearby trees piercing the silpauline sheet, which is spread over the plastic gunnies. About 10 - 15 kg of sieved fertile soil is uniformly spread over the silpauline sheet. Slurry made of 2 kg cow dung and 30 g of Super Phosphate mixed in 10 litres of water, is poured onto the sheet.
More water is poured on to raise the water level to about 10 cm. About 0.5 - 1 kg of fresh and pure culture of azolla is placed in the water. This will grow rapidly and fill the pit within 10 - 15 days. From then on, 500 - 600 g of azolla can be harvested daily.
A mixture of 20 g of Super Phosphate and about 1 kg of cow dung should be added once every 5 days in order to maintain rapid multiplication of the azolla and to maintain the daily yield of 500 g. A micronutrient mix containing magnesium, iron, copper, sulphur etc., can also be added at weekly intervals to enhance the mineral content of azolla.

NARDEP method of azolla production

1. It is important to keep azolla at the rapid multiplication growth phase with the minimum doubling time. Therefore biomass (around 200 g per square meter) should be removed every day or on alternate days to avoid overcrowding
2. Periodic application of cow-dung slurry, super phosphate and other macro and micronutrients except nitrogen, will keep the fern multiplying rapidly.
3. The temperature should be kept below 25 °C. If the temperature goes up the light intensity should be reduced by providing shade. If possible, it is best to place the production unit where it is shady.
4. The pH should be tested periodically and should be maintained between 5.5 and 7.
5. About 5 kg of bed soil should be replaced with fresh soil, once in 30 days, to avoid nitrogen build up and prevent micro-nutrient deficiency.
6. 25 to 30 percent of the water also needs to be replaced with fresh water, once every 10 days, to prevent nitrogen build up in the bed.
7. The bed should be cleaned, the water and soil replaced and new azolla inoculated once every six months.
8. A fresh bed has to be prepared and inoculated with pure culture of azolla, when contaminated by pest and diseases.
9. The azolla should be washed in fresh water before use to remove the smell of cow dung.

Using azolla as livestock feed

Azolla should be harvested with a plastic tray having holes of 1 cm^2 mesh size to drain the water. Azolla should be washed to get rid of the cow dung smell. Washing also helps in separating the small plantlets which drain out of the tray. The plantlets along with water in the bucket can be poured back into the original bed. When introducing azolla as feed, the fresh azolla should be mixed with commercial feed in 1:1 ratio to feed livestock. After a fortnight of feeding on azolla mixed with concentrate, livestock may be fed with azolla without added concentrate. For poultry, azolla can be fed to layers as well as broilers.

Though there is no large-scale incidence of pests and diseases in silpauline based production system, pest and disease problems have been noticed during intensive cultivation. In case of severe pest attack the best option is to empty the entire bed and lay out a fresh bed in a different location.

With this method the cost of production of azolla is less than Rs 0.65 per kilogram, which is equivalent to US$0.015 (see Table 2).

Table 2. Economics of azolla production with NARDEP method

	Cost of production in 4 units during one year	Amount (Rupies)
1.	Cost of 120 gauge silpauline 2.8 x 1.8 x 4 m	400.00
2.	Labour charges for bed preparation	100.00
3.	Cow-dung	146.00
4.	Superphosphate	7.50
5.	Magnesium Sulphate	4.00
6.	Micro-nutrients	15.00
7.	New azolla 200 g x 8 = 1600 g	5.00
	Total cost of production	**677.50**
	Total production in 4 units (1 kg/unit/day for 350 days)	1050
	Cost/kg	**0.65 Rs/kg**

44 Rs = 1US$

Conclusion

Azolla can be used as an ideal feed for cattle, fish, pigs and poultry, and also is of value as a bio-fertilizer for wetland paddy. It is popular and cultivated widely in other countries like China, Vietnam, and the Philippines, but has yet to be taken up in India, in a big way. Dairy farmers in South Kerala and Kanyakumari have started to take up the low cost production technology and we hope that the azolla technology will be taken up more widely by dairy farmers, in particular those who have too little land for fodder production.

■

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This article is a summary of the article "AZOLLA – A sustainable feed substitute for livestock" by P. Kamalasanana Pillai, S. Premalatha, S. Rajamony. The full article was published in LEISA India, Volume 4 number 1, March 2002. It is available on the website www.leisa.info.

Trying it out

After reading the article on azolla in the March 2002 issue of the LEISA India, the LEISA India columnist and organic farmer Mr. Narayan Reddy decided to test the production of azolla on his farm. As his grandchildren were visiting, they were set to dig the first bed of 2 x 3 x 0.15-0.2 m.
To simplify the construction, Mr. Reddy made some adaptations:
He lined the bed with a simple plastic sheet, fixed the sheet with the dug out soil together with some concrete along the edges, taking care that the plastic above the water was well covered – as otherwise the sun will rapidly deteriorate the plastic. After fixing the plastic, about 2 - 3 cm of stone free soil was carefully put back in the bottom of the bed which was filled with water. The water depth is important; too little water will allow the azolla roots to grow into the mud, making it difficult to harvest. Too much water will reduce the production as the roots do not reach close enough to the nutrients at the bottom. After filling the bed, Mr. Reddy went off to the closest university to ask for some azolla plants and put them in the water. He added 0.5 - 1 kg of neem cake to prevent possible pest problems and every three weeks he adds slurry of cow dung and water (10 kg fresh cow dung).

One and a half years later Mr. Reddy is enthusiastic about azolla. He feeds it to his cows and chickens and after getting used to the azolla (in the beginning he mixed the azolla with concentrate) the animals love it. He has had to fence the bed to keep them out. He also uses the azolla for salads, after washing it in fresh water and removing the root.

He empties and cleans the bed once every half year and starts it up again with some plants, neem cake and cow dung. When the temperatures soar in the summer, the bed is covered with a roof of loose palm leaves to give some shade and reduce light and temperature. However, the use of a simple plastic sheet for lining makes the bed very vulnerable – it can easily be damaged during harvesting or cleaning and Mr. Reddy therefore makes sure that he carries out these tasks himself.

With this simple system, the only costs are for the plastic sheet and for 2 kg of neem cake per year – plus his own labour.

Anita Ingevall

Small livestock in the city

Roberto Sánchez, Nelson Aguilar and Fernando Funes Monzote

Nelson Aguilar, a citizen of Cuba's capital Havana, known locally as "the rabbit breeder", is one of many people who have managed to set up a small-scale animal production unit in an urban setting, making use of locally available resources. Defying the belief that people in cities are only consumers, Nelson Aguilar wanted to demonstrate that it is feasible to produce food in urban areas. At the end of 2002, Nelson's old dream of keeping rabbits on the roof of his house became a reality. Supported by the German NGO Bread for the World he attended a series of training courses on the principles of permaculture, organized by the Antonio Núñez Jiménez Foundation for Nature and Humanity (FANJ) and the Cuban Association for Animal Production (ACPA). He learnt about diversified and integrated systems and recycling organic residues and waste, and this helped him start his production system. The experience obtained from daily practice, his dedication and persistence have enabled him to develop the system further.

Farming on a roof

Nelson developed his production system on the roof of his house, an area of 136 m^2. The system consists of an animal and a plant component. Rabbits, guinea pigs and chickens constitute the animal component. Rabbits are the most economically important component. More than one hundred rabbits, including two bucks, 23 does and their offspring are kept in cages that cover a total surface area of 68 m^2. Underneath the rabbit cages there is another confined area, with 40 guinea pigs, and in a nearby 2 m^2 area Nelson keeps 15 chickens of a local breed. The plant component occupies the other part of the roof. Nelson produces mainly condiments such as red pepper, basil, garlic, small onion and oregano, but he also grows medicinal plants like aloe, linden tree or *noni* (*Morinda citrifolia*) and some ornamental plants to make the place attractive and provide shade to the animals. In the winter season cabbage, tomato and other vegetables are grown.

Cages, drinking containers, nesting boxes, and tools were designed and constructed by Nelson using locally available materials. This saved him the expenses, and it enabled him to make specific adaptations to the classic designs so that they would suit his situation and ideas.

Feeds and nutrient flows

The design of the system allows all residues that are produced to be recycled within the system. In this way, the limited feed resources are used as efficiently as possible. The diet of the rabbits consists of fresh grass cut from gardens and green areas in the city as well as fresh vegetable wastes. This part of the rabbits' diet can be difficult to obtain in certain zones of the city. The fresh feed is complemented with dry feed prepared at home, using a self-made chopping device, a gas or electricity-operated dryer and a "hammer mill". This equipment improves the quality of the feed and the efficiency with which it is used. It is simple to handle and guarantees appropriate storage in the hot and humid conditions of Cuba. The homemade feed is made from organic residues from the kitchen, a nearby canteen, vegetable markets and food stores. The ingredients are first ground separately, then mixed by hand and dried. In this way a reserve stock of animal feed can be built up during periods when organic residues are abundantly available. These reserves can be stored for up to six months without losing their quality. Laboratory analyses indicate that this feed contains 11 - 16 percent protein and 12 - 15 percent fibre.

The leftovers from rabbits' feed are consumed in their totality by the guinea pigs. The rabbit and guinea pig manure is collected and part of it is dried. This then makes up 70 - 80 percent of the chickens' diet (with the homemade dried feed accounting for the remainder). The remaining manure is used as a fertilizer for the plants cultivated on the roof, and any excess manure is given to other vegetable growers in the neighbourhood.

Benefits and challenges

The system offers interesting economic benefits to the Aguilar family. The sale of rabbits constitutes the main source of income. The chickens produce 4 - 7 eggs each day, sufficient to cover family needs and to sell or give to neighbours. Guinea pigs are occasionally sold as pets or for breeding, and on occasion some homemade feed is also sold. The net income generated through the system is 1.4 times the average per capita salary in the city. At the same time, the system provides the household with eggs, meat, condiments and medicines, which constitutes a significant monetary saving.

Of equal importance are the social benefits of the system. Nelson has strengthened his relations with his neighbours and the surrounding community, who support his production system by providing him with a range of inputs. The people who provide these inputs also benefit, because they get rid of organic residues that would normally require time and effort to dispose of. People in the neighbourhood also obtain easier access to healthy products that can be bought cheaply or bartered. Local vegetable growers also benefit by receiving free manure. The local environment is improved as waste products are being reused and recycled, avoiding nutrient losses and the contamination of the surroundings.

One of the problems Nelson faces is the fluctuation in the availability and quality of the raw material for feeding the animals. Food shortages will inhibit the growth rates of the animals. Nelson deals with this problem by building up a stock of dried homemade feeds. High temperatures during summer can also cause problems, having a negative effect on reproduction. Nelson is trying to keep the temperature low by letting creepers grow along trellises to supply shade. Diseases are usually not a problem as long as breeders observe stringent hygiene practices.

Conclusion

Nelson's experience shows that urban areas can provide spaces for livestock production. It is estimated that presently there are more than one thousand rabbit breeders in Havana and many other people are keeping chickens. Nelson's experience is special because he is one of the very few who managed to integrate several animal species into one system, providing benefits to his family and community. The promotion of small projects that stimulate these initiatives, offer training and allow for the conversion of small animal production units aimed at self-sufficiency into profitable activities should be a priority in the both urban and rural planning.

■

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An integrated livestock-fish farming system

Juniati

Batu Kumbung, a little village on Lombok Island, is situated in one of the most important fish producing areas of Indonesia. Rice, the main crop, is planted twice a year followed by a secondary crop such as maize or soybean. Many farmers practice traditional rice-freshwater fish farming. In this system farmers keep fish in selected, small rice plots. The fish are fed on a daily basis with leftover rice from the household. Before the rice harvest the fields are left to dry, the fish are collected and consumed by the household, donated to family members or neighbours, or sold at the local market. At the onset of the next rice growing season, the farmers usually obtain new fish seed stock for free, from well-off farmers in the area that have their own hatcheries.

In 1980 Erman Abdul Wahab, the oldest son in the Wahab family, inherited 1.2 hectares of farm land that had been managed under the traditional rice-freshwater fish system by his father. Soon after starting his farming activities, he found out that the traditional rice-fish system had a big disadvantage – the misfit between the growth cycle of rice and the fish maturity. As the rice harvest period approaches less water is needed, so the farmers gradually let the fields dry up and harvest the fish. Erman discovered that the fish were not able to reach full maturity in the limited time span of a single rice crop. As a consequence, he was forced to sell small, underage fish that have a lower value than fully developed mature fish. Another aspect that bothered Erman was that the income from the fish sale was totally dependent on the rice crop cycle.

Integrating livestock

Aware of the disadvantages of rice-fish farming, he started to think about a way to sustain fish production through the year and thereby provide continuous income for the family. At the end of 1980 he obtained a handbook on integrated livestock-fish farming systems. These systems achieve optimal utilization of waste, because the waste produced in one subsystem (livestock) is an input for a second subsystem (fish).

Not wanting to waste his time, he started digging a pond near his house, measuring 7 x 15 metres with a depth of 2 metres. Above the pond, standing on concrete piles, he constructed a 2 x 2 metre chicken house in the traditional style, with a platform made of bamboo and a roof of corrugated iron. The bamboo platform was ideal because it allowed chicken manure to drop directly into the pond. The chicken house was large enough for chickens to roost and nest. It was designed in such way that it was well ventilated but would protect the chickens from the weather, predators and injury. Plastic drinkers and feeders were placed inside the house.

After finishing the pond and the chicken house he transferred hundreds of fish from his field to the pond, including gouramy, carp and a species of tilapia called *mujair*, this being a common combination of species in Indonesia. He introduced 25 chickens into the pen, taking good care of them and making sure that the house was kept clean and dry. Chicken feed had to be bought in town, but feeding the fish incurred no cost at all, since they fed on the chicken manure that dropped into the pond.

The results were positive and five years later he decided to increase the size of the chicken house to its present dimensions (7 x 2 metres) and increase the number of chicken to four hundred. The number of fish has also increased.

Now, after 25 years of integrated livestock-fish farming, Erman is convinced that the system offers significant profits. Income from fish sales is continuous and not dependent on the rice crop cycle. The fish in the pond grow much bigger than those from the rice fields because the chicken manure provides more nutrients than the leftovers of rice that fish receive in the traditional system. Bigger fish sell at a higher price: the big healthy fish from the pond fetch up to US$ 1/kg, compared to US$0.20/kg for immature fish from the rice fields. Erman estimates the monthly net income from fish to be around US$150, while the income from fish in the traditional system is about US$50 per rice production cycle. The additional income from the chicken is also significant. Although it is necessary to purchase feed and medicine, the chickens offer a very attractive monthly net income of US$120. The total net income from integrated livestock-fish farming is almost twice the average monthly salary of a government officer (US$150). The family not only enjoys a proper standard of living, but also have easy access to good, protein-rich food, such as fish, meat and eggs.

Challenges and opportunities

Erman and his family have shown that integrated livestock-fish farming is a viable and profitable business, and their experience has become an inspiration for his neighbours and governmental staff. Even so, adoption of the system has been low. The major problem to the successful adoption of this integrated farming system appears to be the high cost involved in pond construction. Other reasons for low levels of adoption are related to developments outside the farm sphere. Rapid population growth is leading to urbanization of rural areas, and growing industrial development and tourism encourage people to become active in off-farm income-generating activities. These socio-economic changes pose a real challenge to sustainable rural development, but may also create new opportunities as food production also needs to increase. The government is becoming more aware of this and is now re-promoting small-scale livestock-fish farming that may serve the future needs of the rural population as well as other sectors of society. ■

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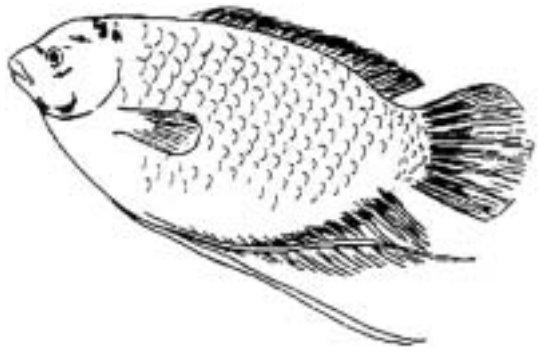

Research and training in livestock-based sustainable farming systems

Brian Ogle

Photo: Author

MSc student Nguyen Duy Quynh Tram sampling fish as part of her research project on a farm in Hue, Central Vietnam.

Agricultural research and university teaching programmes in the tropics have usually concentrated on the large-scale, conventional livestock production systems developed in industrialized countries. These systems have proved to be "successful" with respect to increasing the total production, but require sophisticated and expensive technologies and often lead to environmental problems. Training and research based on this type of production system have resulted in a lack of appreciation of the role of livestock in agricultural systems for smallholders and a lack of interest in the small scale farmers who make up a major part of the population and account for a large part of agricultural production in the South.

The MEKARN programme is trying to address these issues. It is a regional network focusing on training and research in sustainable livestock-based agricultural systems in South East Asia. The network includes 13 university departments and research institutes in the four countries of the Lower Mekong Basin (Laos, Vietnam, Cambodia and Thailand), all sharing the same agro-ecological conditions and the need to develop smallholder agriculture, which is still the backbone of the rural economies of these countries.

Programme focus

The programme focuses on promoting livestock as an essential part of sustainable farming systems. It aims to provide information, which will enable small farmers to increase the productivity and efficiency of their livestock as a part of sustainable, integrated farming systems that make optimum use of locally available resources. In turn this will increase food security, reduce poverty and environmental problems in rural areas.

Traditional smallholder agricultural systems are often sustainable and environmentally friendly, but are now under pressure from large-scale commercial farming, increasing use of agro-chemicals and decreasing farm size. We think it is important that MEKARN continues to focus on research and development into the more efficient integration of livestock with cropping, agroforestry or fruit trees, water plants and aquaculture**.** This involves the recycling of nutrients and use of locally available feeds, and will thus make the systems more sustainable. Another important way of increasing sustainability is to make more efficient use of agro-industrial by-products and crop residues.

Project activities

The MEKARN programme develops the research and training capacity of the cooperating institutions through postgraduate training, short-courses, and through carrying out on-station research, backed up by on-farm studies. It also tries to strengthen cooperation in research and training, increase the availability of information in the Lower Mekong Basin as well as promote the exchange of ideas, experiences and information between institutes in the four countries.

Master of Science programme

The programme consists of 8 months of coursework and a 14-month research project. The courses are held at different universities and research institutes in the four countries, which exposes the students to the agricultural systems and cultures of their neighbours. The courses centre around the knowledge and technologies needed to further develop sustainable agriculture in the region. The training is very hands-on and holistic, oriented towards the problems facing resource-poor farmers, and emphasizes ecological awareness. Students are trained to find information themselves, for example from the Internet, and to work without relying on facilities such as well-stocked libraries or expensive laboratories. The studies generally consist of both on-station and on-farm work, with a condition being that the results should be of direct value to smallholders. So far, the students have obtained their degrees from the Swedish University of Agricultural Sciences but in future, it is expected that a consortium of universities in the region will award the degree.

PhD programme

PhD candidates are normally selected from previous MSc graduates. The research is carried out in the student's home country, and normally focusing on actual farmer problems. Around 18 months of the 4-year programme are spent in Sweden, to plan the research, take courses and then write up the thesis. Examples of some ongoing studies:

- Studies on the utilization of agro-industrial by-products for ducks in the Mekong Delta of Vietnam
- Cassava foliage as a protein source for pigs and poultry in Cambodia
- Effect of supplementation of scavenging chickens on feed intake, nutrient digestibility and performance in Vietnam
- Mycotoxin contamination of feeds in Vietnam
- The effect of cassava foliage on internal parasites of small ruminants in Cambodia
- Animal and feed factors affecting feed intake, behaviour and performance of small ruminants in Vietnam
- Cassava management and feeding systems for smallholder goat production in Laos

Networking and outreach

The MEKARN programme works to strengthen the cooperation in research and training, increase the availability of information and promote livestock as an essential part of sustainable farming systems in the Lower Mekong basin. A website (http://www.mekarn.org) provides up-to-date information on project activities. Regional workshops are held annually and the

proceedings are published on the website, in paper form and on CD-ROM discs. Training material based on research findings is produced for scientists and agriculturalists in the region and study tours and exchanges are encouraged and supported.

An example of farmer adoption of the findings from on-farm trials concerns the preservation of cassava roots in Vietnam. Cassava is one of the most important crops for small-scale farmers in Central Vietnam. The roots are normally sold cheaply to factories, as they are harvested in the rainy season, when it is not possible for the farmers to preserve them by sun-drying for later use. Researchers at Hue University of Agriculture and Forestry, together with the local Women's Union, tested a method for ensiling the fresh roots that involved grinding them, adding salt, compacting the mixture and placing it in sealed plastic bags. Ensiling for several months reduced the content of toxic cyanide to safe levels and the silage was shown to be an excellent and cheap source of energy for fattening pigs. The technique has since been widely adopted by farmers in the region. ■

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FIELD NOTES

Good care of goats pays off!

Leariwala Jeremiah

Emuria Ekai and his family had no option. Life in Kolua village had become unbearable after they had to sell their last goat and they were forced to migrate to town in search of a job. In 2000 they arrived in Archer's Post town in Samburu District, Kenya. Finding employment wasn't easy but Emuria managed to obtain a small income by digging pit latrines, fetching water and collecting firewood. After some time he was lucky enough to be employed at a butchery and his earnings were sufficient to buy food for the family and save a bit of money.

Emuria soon discovered that goats could be purchased cheaply in the animal market. The drought of 2001 caused many goats to become thin and weak, lowering their market value. Old goats were also brought to the market and were sold for as little as 200 Kshs (about US$3). Emuria and his wife scraped together sufficient money to buy two weak goats. He was convinced that the goats could recover their health if they were given proper care. Emuria tied the two goats to a pole in a shaded area near his work. Every day he would use his work breaks and free hours to visit vegetable vendors, collect cabbage leaves, potato peels, spoilt tomatoes and other wastes, and feed these to his goats. He bought de-worming tablets from the veterinary shop and gave them to his goats. He treated them for ticks and injected vitamins to hasten their recovery process. He continued feeding them with the abundant market wastes until his goats were able to walk the distance to his house and back to the town centre. This became the daily routine: during daytime he would leave the goats to roam the market freely and feed on vegetable wastes, and in the evening he would take them home. He bought two more weak goats and gave them similar care and treatment, until they were able to roam jointly with the first two goats.

When the rainy season finally arrived, his four goats were strong and two were ready for mating. He took them to a neighbour who owned some male goats. The mating proved successful as Emuria expected. Faced with the growing goat herd, Mrs Emuria decided to build a thatched shed next to the house, with mud walls to keep out the cold, wind and rain. The shed protects the goats and helps them avoid the diseases that commonly affect goats exposed to these climatic conditions.

Photo: Author

Starting with one weak goat five years ago, Emuria's family now own a healthy stock of goats, thanks to proper animal care.

Today, the family has 35 goats, and Emuria is confident that number will increase even further. Asked why he is so interested in old and weak goats, he says that these are cheaper but still have the potential of raising new stock. If weaker goats are treated, fed well and housed properly they recover quickly and start bearing healthy kids again. Most of Emuria's kidding goats bear twins most of the time, which he attributes to good feeding and health. The kids grow faster and he has never experienced kid mortality resulting from poor health or malnutrition. In terms of meat and skin production, his goats weigh more than the local goats that rely only on the natural pastures found on the communal grazing land. Their skins are of good quality due to the good house and lack of ticks.

Every month Emuria slaughters one goat and sells its meat to earn his family some extra income. He uses part of the money to buy drugs and cheap goats. He recently bought some sheep as well, because, like goats, they feed on many types of vegetable waste, are easy to keep and offer many benefits to the family. ■

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Gracias a los animales: análisis de la crianza familiar en Latinoamerica, con estudios de caso en los valles y el altiplano de Bolivia by Hooft K. van 't (ed.). 2004. 482 pp. ISBN 99905 75 48 7. US$12.00 (plus postage); in Europe and North America: US$25.00 (plus postage). Within the Andean region this book is available in the major bookshops. It can also be ordered by contacting Agroecología Universidad Cochabamba (AGRUCO), Av. Petrolera km 4 ½ (Facultad de Agronomía), Casilla 3392, Cochabamba, Bolivia. Email: agruco@agruco.org

This beautifully illustrated book presents the most important aspects of family-level livestock keeping in Latin America. The aim of the book is to present a holistic analysis of family-level livestock rearing in the Bolivian valleys and the *Altiplano*, based on the experiences of rural families as well as projects that work with them. It explains the rationale behind the rearing of livestock by families, aiming to break away from the common perception that low input small scale livestock production is `backward', which needs to be transformed into a more specialized, market-oriented system for development to occur. The book starts with a description of the differences between the western and Andean visions of life and technology. It then presents an analysis of the different systems used in family-level livestock keeping, varying from diversified to more-specialised livestock keeping. The major part is dedicated to case studies of family livestock keeping of 11 commonly used animal species: milk cattle, pigs, fowl, sheep, goats, llamas, alpacas, guinea pigs, angora rabbits, bees, and fish (carp). The final chapter presents a description of the most important diseases that can be transmitted from animals to humans. This publication can be used by students and teachers in agricultural schools, professionals in local NGOs, members of local organizations of livestock producers, rural teachers and community animal healthcare workers. The case-study methodology used is also applicable in other areas with different agroecosystems. It can be ordered from the Information and Documentation Centre of Bolivia CEDIB (Email: cedib@cedib.org)

Animal production/Production animale/Produção animal: Agromisa 1934-2004 2004. CD-ROM. ISBN 90 77073 97 3. € 11.80. Agromisa, P.O. Box 41, 6700 AA Wageningen, the Netherlands. Email: agromisa@agromisa.org ; www.agromisa.org
CTA, P.O. Box 380, 6700 AJ Wageningen, the Netherlands. Email: cta@cta.nl ; www.cta.int

This CD-ROM contains 12 Agrodoks on animal production in English, French and Portuguese. It has been prepared by Agromisa, with support from CTA, to mark the occasion of Agromisa's 70th anniversary in 2004. Agrodoks are a series of low-priced, practical, manuals on small-scale and sustainable agriculture in the tropics. A number of them are about keeping small animal in the tropics. The CD-ROM provides the manuals on pig keeping (number 1) poultry production (#2 and 34), fish farming (#15 and 21) backyard rabbit farming (#20), duck keeping (#33), beekeeping (#32) and goats (#7). Each manual is also individually available as printed booklet. *The printed manuals are available from Agromisa or CTA in the same way as the CD-ROM. Those registered with CTA's Publications Distribution Service may obtain Agrodok publications using their credit points and a CTA Publications Order Form. Applications will be considered from organizations and individuals active in agriculture and rural development and established in ACP (African, Caribbean and Pacific) countries.*

Beekeeping and sustainable livelihoods by Bradbear N. 2004. 62 pp. ISBN 92 5 105074 0. US$16.00. FAO Diversification booklet 1. FAO, Viale delle Terme di Caracalla, 00100 Rome, Italy. Email: Publications-Sales@fao.org ; www.fao.org

The Food and Agriculture Organization of the United Nations (FAO) Diversification booklets aim to raise awareness of, and provide information about, opportunities at the farm and local community level to increase small-scale farmer income. This first booklet in the series underlines the importance of bees in agriculture, both as pollinators and as an income-generating activity for small scale farmers. The booklet was reviewed in LEISA Magazine issue 20.4.

Poultry for profit and pleasure by Alders R. 2004. 39 pp. ISBN 92 5 105075 9. US$14.00. FAO Diversification booklet 3. FAO, Rome, Italy. (details see above)

This booklet, part of the same series explores the potential benefits associated with poultry keeping, as well as appropriateness and viability in differing circumstances. It is aimed at informing project designers, donors, development agencies and development workers about the many ways in which poultry can help rural people to improve their livelihoods. Poultry production can contribute to sustainable food security in many developing countries by providing income to poor farmers, especially women. It makes good use of local resources, requires few inputs and makes important economic, religious, social and cultural contributions to household livelihoods. The booklet does not provide technical guidelines but the last chapter does provide details of complementary sources of information and technical support. Recommended.

Grasscutter domestication: teach yourself farming by Akinbile S.M. 2004. 22 pp. ISBN 978 3572628. Erodise publication productions, P.O. Box 231, Ikere, Osun state, Nigeria. Email: erodise@yahoo.com

Grasscutter (*Thyonomys swinderianus*) also referred to as cane rat, is found in the forests and savannas of West Africa. It is a non-burrowing large size rodent with good tasting meat. It used to be an important source of "bush meat" in Western Africa but the species has nowadays become rare. Domestication of the cane rat has proven successful and the demand for its meat ensures a ready market. This small manual provides the starting farmer with practical information on how to rear this species successfully. This useful booklet is easy to read, very clear and complete.

Snail rearing : teach yourself farming by Akinbile S.M. 2003. 16 pp. ISBN 978 0474471. Erodise publication productions, P.O. Box 231, Ikere, Osun state, Nigeria Email: erodise@yahoo.com

The same author, Stephen Akinbile, has also written a useful small manual on snail farming. Snails are among the easiest of animals to rear, since they are not harmful and do not need much space or expensive inputs. Anyone who is looking for a venture to augment his/her salary and with a little available space and patience can engage in snail farming. The bulk of snails that are consumed in Nigeria are gathered from nature and sold in the local market. This booklet is intended to prevent the African giant land snail from extinction by teaching people the practical methods of rearing snails.

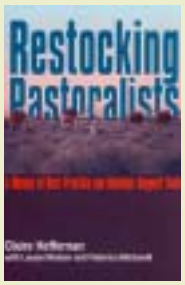
Farm animal genetic resources: safeguarding national assets for food security and trade by Köhler Rollefson I. 2004. 54 pp. + CD-ROM. Downloadable free of charge. GTZ, FAO and CTA. Available from DAD-IS, http://dad.fao.org/en/refer/library/reports/farmAnimalGeneticResources.pdf Email DAD-IS@fao.org or GTZ, Postfach 5180, 65726 Eschborn, Germany.

Three quarters of the farm animals in the Southern African Development Community (SADC) belong to smallholders and consist mostly of indigenous breeds. Policy makers in the region strive for strategies to increase the productivity of the livestock sector and to improve and conserve the genetic basis. This book is based on a series of four workshops aimed at national coordinators of the management of farm animal genetic resources of the SADC, but also with participation from NGOs, the private sector and other relevant stakeholders. It synthesizes and contextualizes the contents and conclusions of the four workshops and though aimed at the SADC region its findings are relevant worldwide.

This publication is meant for further awareness raising and is available on paper as well as electronically. It is accompanied by a CD-ROM, containing the full outputs of the workshops.

Restocking pastoralists : a manual of best practice and decision support tools by Heffernan C., Nielsen L., Misturelli F. 2004. 110 pp. ISBN 1 85339 589 7. US$23.95. ITDG Publishing, Bourton Hall, Bourton-on-Dunsmore, Rugby, Warwickshire, CV23 9QZ, UK. Email: orders@itpubs.org.uk

Pastoralist populations are among the world's most vulnerable citizens. Drought, civil war, population growth, land encroachment and the growing commercialization of economies have contributed to the widespread impoverishment of many pastoralist societies. Recently the development community has responded to the growing destitution of pastoralists by implementing restocking projects. Restocking is seen as a means of supporting food and livelihood security in both the short and long term. Nevertheless the long-term benefits of restocking projects have been disappointing. This manual responds to previous failures by offering a new client-driven approach based on best practice and supported by a wide range of practical tools. The book draws on the experience of over 85 restocking projects from Africa, Asia and Latin America. It is designed for practitioners in NGOs, relief and development agencies and national agricultural research systems and provides a complete guide to successful restocking.



Primary animal health care in the 21st century: shaping the rules, policies and institutions: Proceedings of an international conference held in Mombasa, Kenya, 15-18 October 2002 by Sones K.R., Catley A. (eds). 2003. 68 pp. African Union/Interafrican Bureau for Animal Resources, P.O. Box 30786, 00100 Nairobi, Kenya. Email: jotham.musiime@oau-ibar.org ; www.cape-ibar.org

There are increasing opportunities to develop more sustainable, basic veterinary services in rural areas, yet there is also a need to ensure that these new services also help countries to be able to sell livestock and livestock products in the global market. This conference focused on both these objectives, reviewing policies to support the provision of primary animal health care and legislation relevant to workers in the field, identifying lessons learned and making recommendations for further action to meet policy and legislative needs. Participants from across the whole world, especially from African countries, represented a wide spectrum of animal health specialists including government officials, NGOs and private-sector companies. This report summarises the presentations, discussions and recommendations of the conference. One conclusion to emerge is that community animal health workers (CAHW) are proving useful, but their management and integration into existing systems must be improved. Strengthening the delivery of veterinary services requires building more effective links between vets, paravets, CAHWs, farmers and farmers' organizations. This summary report is complemented with a CD-ROM containing the full papers of the presentations.

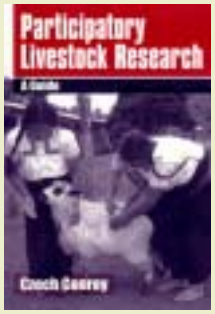
Pig feed improvement through enhanced use of sweet potato roots and vines in northern and central Vietnam: a practical guide for farmers and extensionists to raise pigs efficiently with local feedstuffs by Peters, D. 2005. 74 pp. Free of charge, delivery costs only. International Potato Center CIP, Hanoi, Vietnam. Email: ntinhop@netnam.vn
CIP-UPWARD, c/o IRRI DAPO Box 7777, Metro Manila, Philippines. Email: cip-manila@cgiar.org ; www.cip-upward.org

Scientists from UPWARD, the International Potato Center Vietnam (CIP) and Vietnamese collaborators from various institutions and disciplines have been working together to improve the sweet potato-based pig feeding system in northern and central Vietnam. The avenues for improving this system consist of three approaches: selection of varieties most suited for pig feed; sweet potato root and vine processing to improve nutritional value, and improved pig feeding and management to enhance growth efficiency.

This book provides a summary of the four programs that have been conducted since 1997 in different agro-ecological regions of Vietnam where sweet potato is an important source of pig feed. The book will be of interest to sweet potato-pig farmers and agricultural extension workers who have responsibilities in rural household crop and pig production. A Vietnamese-language version is also available.

Participatory livestock research: a guide by Conroy C. 2005. 304 pp. ISBN 1 85339 577 3. US$26.96. ITDG Publishing, Bourton Hall, Bourton-on-Dunsmore, Rugby, Warwickshire, CV23 9QZ, UK. Email: orders@itpubs.org.uk

This book is about participatory research, which covers two broad areas. The first is participatory situation analysis (PSA), in which researchers and local people collaborate in developing a sound understanding of the local situation in animal husbandry. This kind of research may then be followed by participatory technology development (PTD), which is the second type of research covered in this book. This book is divided into three main parts. Part I describes the general philosophy and approach of PSA, and a range of tools, with examples of their application to animal production and health. Part II describes when and how to conduct PTD. Part III contains ten case studies of PTD with livestock-keepers that describe how this approach has been used to address a wide range of issues with different types of livestock in several developing countries. The author has worked in various countries in Asia and Africa and draws on experiences with collaborative goat and poultry research in India and in the case study projects in Part III. It is essential reading for those involved in livestock research and will also be of interest for extension workers and practitioners in agricultural service agencies.



Pro-Poor Livestock Policy Facility (PPLPF)
www.fao.org/ag/againfo/projects/en/pplpi/home.html
FAO, Viale delle Terme di Caracalla, Rome 00100, Italy.
E-mail: joachim.otte@fao.org
Initiative to facilitate and support the formulation and implementation of policies and institutional changes that have a positive impact on the livelihoods of a large number of the world's poor.

Livestock, Environment And Development (LEAD)
http://lead.virtualcentre.org
Email: mauricio.rosales@fao.org
LEAD is a multi-institutional initiative of FAO formed to promote ecologically sustainable livestock production systems. It promotes research on livestock environment interactions.

International Network for Family Poultry Development (INFPD)
www.fao.org/ag/againfo/subjects/en/infpd/home.html
Email: emmanuelle.guernebleich@fao.org
INFPD is mainly an Information Exchange Network.
INFPD Newsletter:
www.fao.org/ag/againfo/subjects/en/infpd/newsletters.html

The HEIFER International Network
www.heifer.org
HEIFER International, 1015 Louisiana Street, Little Rock, Arkansas, 72202 USA.
HEIFER's mission is to work with communities to end hunger and poverty and to care for the earth. Its strategy is based on the principle: "pass on the gift." As people share their animals' offspring with others – along with their knowledge, resources, and skills – an expanding network of hope, dignity, and self-reliance is created that reaches around the globe.
HEIFER, The Exchange: Appropriate livestock technology for a developing world. Subscriptions are free.
Email: exchange@heifer.org
The Heifer International Exchange newsletter is the quarterly publication of Heifer International devoted to small scale animal production in developing areas.

League for Pastoral Peoples and Endogenous Livestock Development
www.pastoralpeoples.org
Email: info@pastoralpeople.org
This is an advocacy and support group for pastoralists who depend on common property resources.

LIFE Local Livestock for Empowerment of Rural People
www.lifeinitiative.net
Email: evelyn@mamud.com
LIFE is a group of organizations and individuals who promote community-based conservation and the development of indigenous livestock breeds and species.

Vétérinaires Sans Frontières (VSF) Europa
http://www.vsfe.org
Animal health network

Ethnovetweb
www.ethnovetweb.com
Evelyn Mathias, Weizenfeld 4, 51467 Bergisch Gladbach, Germany;
Email: evelyn@mamud.com
This website is about ethnoveterinary medicine, or how people around the world keep their animals healthy and productive, and how development can build on this information.

Traditional animal health care
http://bcics.uvic.ca/bcethnovet/
Cheryl Lans, Email: trini@uvic.ca
Online global database of ethnoveterinary research.

ANTHRA
www.anthra.org
A-21 Sainikpuri, Secunderabad – 500094, Andhra Pradesh, India
Email: information@anthra.org
Anthra is a non-profit organization of women veterinary scientists working primarily on issues of livestock development, in the wider context of sustainable natural resource use.
The members work in Maharashtra and Andhra Pradesh, India.

Vetwork
www.vetwork.org.uk
Stephen Blakeway, 35D Beach lane, Musselburgh, EH21 6JX, UK.
Email: stephen@vetwork.org.uk
Vetwork is a British NGO that promotes participatory livestock development. Their site presents information, an electronic magazine and contact addresses relating to community-based animal healthcare.

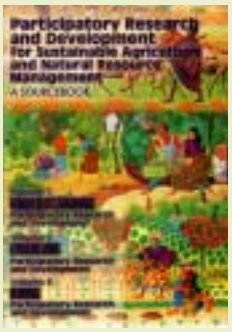
Bees for Development
www.beesfordevelopment.org
Troy, Monmouth, NP25 4AB, UK. Email: info@beesfordevelopment.org
Bees for Development helps people worldwide to create sustainable livelihoods with bees.
Bees for Development Journal ISSN 1477-6588. US$ 28.–.
Published quarterly by Bees for Development, UK Bees for Development publishes this quarterly journal for readers in more than 130 countries. It provides information and support to beekeepers in developing countries worldwide. This journal covers every aspect of bees, beekeeping and apicultural science, including conferences, workshops, new books and articles on practical beekeeping. It provides a wealth of information for existing and aspiring bee enthusiasts.

Fish for All
www.fishforall.org
The World Fish Center, P.O. Box 500, GPO, 10670 Penang, Malaysia.

NAGA: The WorldFish Center quarterly
http://www.worldfishcenter.org/naga/naga27-3n4.htm
The Naga is a quarterly magazine published by WorldFish Center as part of its efforts to promote research and disseminate research results as widely as possible, and to create a strong network of institutions and scientists who can work together and exchange ideas.

Livestock Research for Rural Development
www.cipav.org.co/lrrd
The international on-line journal on sustainable livestock-based agricultural research. Published by CIPAV, Cali, Colombia. The information is searchable and downloadable.

University of Tropical Agriculture Foundation
www.utafoundation.org
Contact: Preston T, Email: regpreston@utafoundation.org
UTA, Colombia, provides an alternative approach to the classical lecture-room based curriculum, by basing the course on the strong foundation afforded by learning practical skills in a real 'on-farm' situation, further building on this by developing research projects where the results have to be applied.



Participatory research and development for sustainable agriculture and natural resource management: a source book

Volume 1. Understanding participatory research and development; Vol 2. Enabling participatory research and development; and Vol 3. Doing participatory research and development + CD-ROM by Gonsalves J., Becker T., Braun A., Campilan D. [et al.] (eds) 2005. ISBN 9716140320. CIP-UPWARD and IDRC, IRRI DAPO 7777, Metro-Manilla, Philippines.
Email: cip-manila@cgiar.org

Participatory Research and Development (PR&D) can be described as "doing research and development work *with* people" instead of "doing research and development work *for* people". Participatory approaches place farmers and their livelihoods at the centre of the innovation process. This sourcebook aims to inspire and guide aspiring and new practitioners of PR&D to learn, reflect and constantly refine the way in which they work. The target users are field-based researchers in developing countries involved in activities dealing with the interrelated issues of natural resource management, agriculture and rural livelihoods. They may have technical or social science backgrounds but share a common interest in drawing on the PR&D knowledge base. The sourcebook is intended to enhance access to systematized information on field-tested PR&D concepts and practices among field practitioners and their organizations. It provides a general reference and comprehensive overview, showcasing the rich diversity of perspectives on PR&D. The printed version consists of three volumes in a box. The first volume on Understanding PR&D is devoted to overview papers, key concepts, and emerging approaches and frameworks. The second volume on Enabling PR&D includes papers on capacity development; strengthening institutions and organizations, networking and partnerships; policy, governance and scaling up. The final volume on Doing PR&D focuses on technology development, facilitation of local institutions, and organization of communities and stakeholder groups.
The printed version is accompanied by a CD-ROM which provides all the papers in digital form (pdf files). The papers are also downloadable from website www.cip-upward.org. The publishers and authors encourage readers to quote, reproduce, disseminate and translate the papers from this sourcebook. Full reference to the author(s) and the sourcebook is requested.

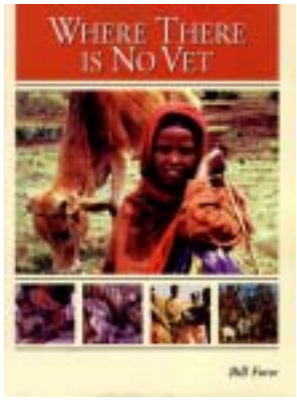
CTA: publishing for impact

Have you been stimulated by this issue of the LEISA Magazine to find out more about livestock management? Perhaps taking a look at CTA's on-line catalogue would help. CTA's publications aim to support organizations and individuals working in the agricultural sector of African, Caribbean and Pacific countries. They deal with socio-economic as well as technical issues. Publications range from the popular "how to do it" *Agrodok* series (see p 32) to carefully researched reference books intended for training and study. All publications in CTA's catalogue are distributed according to a credit point system. Co-publications are also available through commercial outlets.

Like *Anancy*, the mythical spider that gave her name to the CTA's on-line knowledge portal, CTA's concern is to spread knowledge and to ensure that as many people as possible access and share relevant information. This is why it targets (among others) community organizations, farmers' associations, youth and women's groups, and rural community centres. The books will be read, discussed and used for training within these organizations, and perhaps even translated and re-published in local languages. Individuals such as small-scale entrepreneurs and extension officers can also apply for CTA publications because they can use them in their work.

One of CTA's most popular publications is "*Where there is no Vet*". The book – co-published with Macmillan and OXFAM – provides practical information to help farmers understand common livestock problems and to overcome difficulties in using their own local knowledge, remedies and resources.

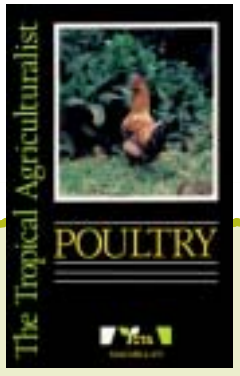
Another example is "*L'élevage d'aulacodes*", a recently published booklet that CTA co-published with GRET in the French series of *Agridoc*. It deals with the successful rearing of the grasscutter or cane rat in Côte d'Ivoire, an activity that has become an important source of protein and income for small-scale farmers.

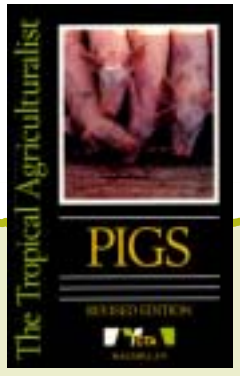


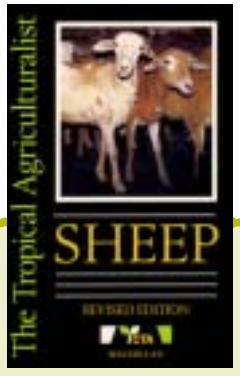
Then there are 44 handbooks in the *Tropical Agriculturalist* series. Recent titles dealing with livestock issues include *Pigs*; *Sheep*; *Livestock: behaviour, management and welfare*; and *Poultry* – an all-time best seller!

Resources are limited and the demand for books is intense. With a carefully managed distribution policy and increasing digitalization, CTA is working to extend the reach and impact of its information services. The recent CD-ROM containing all the *Agrodoks* on animal husbandry published in English, French and Portuguese is an example of the valuable tools CTA is providing to rural resource centres and libraries in ACP countries.

For more information contact CTA at P.O. Box 380, 6700 AJ Wageningen, the Netherlands, or www.cta.int







Migratory duck farming in India

Photo: Author

Migratory duck farming offers benefits for the duck owner, land owners and farm labourers.

G.S. Unnikrishnan Nair

Paddy cultivation and duck farming have always been closely interlinked in the Trivandrum district of Kerala, the southernmost state of India. The ducks are released on paddy fields after harvest, feed on leftover rice grains and in the process enhance soil fertility through their droppings. However, during the last two decades paddy cultivation in the area has substantially decreased because of increased urbanization, changing cropping patterns (whereby rice is gradually replaced by higher value crops such as vegetables and bananas), and migration of young people away from rural areas. This development has forced farmers to purchase feed for the ducks all year round, making duck farming expensive and unsustainable. But "necessity is the mother of invention" and farmers have developed an alternative that enables them to keep duck farming profitable.

Let the march begin!

Many farmers in Punchakkari area of Trivandrum keep duck flocks of 5 000 - 10 000 birds. The ducks, mostly local breeds like *chara* and *chempalli*, are kept for egg production, and are sold or slaughtered at four years of age. Demand for the nutritious duck meat is high and the price is good: It fetches up to 70 Indian rupees (US$1.61) per kilogram, compared to 50 Indian rupees (US$1.15) for chicken meat. During part of the year, the ducks used to feed on rice grains on the farmer's paddy fields and other fields nearby, but confronted with the decreasing areas under paddy cultivation the farmers introduced a system of "migratory duck farming", which provides benefits to the duck owner, farm labourers and paddy field owners in the district and beyond.

Migratory duck farming depends on the paddy fields of Kerala and the neighbouring state of Tamilnadu, where farmers own large paddy fields and grow up to 3 rice crops a year. By February, as the harvest of the second crop of paddy is over, the duck owner splits the flock into groups of 500 birds each and employs 2 labourers to escort each group. The groups then undertake a long four-month journey that ends in Tamilnadu, covering hundreds of paddy fields on their path. The ducks feed on paddy grains, wild rice, snails and small fishes. During the night they stay on garden lands near the fields and the labourers keep guard in turns to chase away wild cats and foxes. The land owners receive duck eggs as remuneration. During the journey eggs are also sold to shops and individual households. They are in high demand because they are said to be beneficial for people with diseases such as piles (haemorrhoids). One duck egg fetches an equivalent of US$0.10. The duck owner pays weekly visits to each group and collects the money obtained from the egg sales. By the end of May, when the fields in Trivandrum are prepared for the first paddy crop, the groups make the return trip home by truck. This allows the labourers to start with their regular field work. Back at the farm the ducks are kept in poultry houses made from locally available materials. Farmers purchase wheat and paddy grains to supplement the ducks' diet.

Benefits

Migratory duck farming caught full momentum during the 1990s, and is still popular because of the benefits it offers to all parties involved. The duck owners now have two options for selling ducks: They can sell duck meat in their district as before, or they can sell 4-year-old live animals at 60 Indian rupees for a 2 kg duck to large Tamilnadu duck farmers. Farmers generally prefer the latter option because it leaves them with fewer ducks at the end of the trip, which saves transport costs back home. It also saves the labour involved in slaughtering ducks, and enables them to sell large numbers of ducks simultaneously. Part of the sales earnings in Tamilnadu can be reinvested by buying ducklings from the Tamilnadu duck farmers. Additional income is obtained from the sale of duck eggs during the journey. Farm labourers also benefit from the system. They usually work in the paddy fields from May to February, but may find it difficult to find employment during the lean period. By getting involved in migratory duck farming they earn 100 Indian rupees per day during the off-season. The landowners of the paddy fields visited during the journey obtain benefits as well. They receive duck eggs as remuneration for making their land available. They also welcome duck manure that fertilizes fields and gardens. And as for the marching ducks: they enjoy a feast all the way!

■

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