Annex D: Selection of Portraits of Sustainable Projects and Initiatives

LATIN AMERICA

1. Argentina: No or Zero-till farming

Zero- or No-Till is a farming system that replaces traditional inversion ploughing. After harvest, the crop residues are left on the field as protection against soil erosion. At planting, the seed (and fertilizer, if required) is slotted into a groove cut into the surface of the soil. Weeds are often, but not always, controlled with herbicides. This means that the soil surface is always covered, and the soil itself never inverted. Farmers use a range of IPM, rotational and precision methods for pest and nutrient management. For example, black oats are now commonly used in the rotation during winter for both soil cover and weed suppression. Other legume cover crops are used to improve nitrogen supplies.

In Argentina, ZT was first tested by farmers in the late 1980s, and by 1990, there were about 100,000 ha of ZT. The 1990s, however, saw remarkable growth in the technology – rising to some 7.3 million hectares in 1999, and covering 30% of all Argentinian arable land. ZT has also spread rapidly in Paraguay and southern Brazil over the same period.

There are several reasons for this rapid spread:

i) significant private benefits for farmers – yields of maize have grown 37% from 2 to 3.5-4 t/ha with ZT, and soya 11% to 2.47 t/ha. Costs have fallen through reduced energy use, more efficient use of inputs, reduced demand for labour (from $50-70 to $30 per ha), and improved farm assets through increased organic matter content in soils, better pest control and improved water retention;

ii) significant public environmental benefits, through reduced soil erosion and water pollution (of pesticides and nitrate), and increased carbon sequestration in soils;

iii) direct support and promotion by farmers organisations themselves, in particular AAPRESID (the Argentinian No Till farmers' organisation) – as Roberto Peiretti puts it: *"the adoption of NT in Argentinian and neighbouring countries was a farmer-led movement… [and] attributed to the common sense of farmers and their ability to detect new economic, physical and other advantages of the system."* Local ZT farmer research and extension groups have been formed, and these linked to regional and national groups. Such coalitions of farmers have been critical in the continued development, adaptation and spread of ZT technology.

Sources: Roberto Peiretti, Don Reicosky; Peiretti, 2000

2. Bolivia: PRODINPO (Integrated development programme, World Neighbors, Northern Potosí)

World Neighbors has been working in the high mountains of Bolivia (2800-4000 masl) in Northern Potosí on improving potato productivity sine the 1980s. The sandy loam soils suffer from acute erosion, and high population densities have forced cultivation of slopes of up to 50 degrees. High rates of non-literacy, a lack of agricultural research and extension outreach, and deep local suspicion posed severe challenges for the project. In addition, the areas infant mortality rate was 200/1000; maternal mortality 100/1000, and average life span a mere 36 years.

At first the project sought to improve livestock and maize production. But after failures, farmers asked them to focus on potatoes. Their interest was in testing new varieties that might help to improve food security using traditional agricultural practices. Crop performance varies dramatically from one hillside

to another, and from one ravine to another, and so learning to account for this variability was a central part of the project – which set out to build farmers' own capacity to experiment with new technologies, and to adapt them to their own circumstances. Communities elect their own farmer promoters to help spread lessons learned as well as be the conduit for improved training.

Farmers have evaluated many varieties of potatoes in on-farm trials, adopted uniform spacing and deep cultivation, tested green manures (especially lupins) and animal manures, and experimented with variations in seed size. Some 2000 farmers have improved potato production from about 4000 k/ha to 10-15,000 kg/ha.

An example of the ways this project has broken away from the norms of agricultural practices centres on the adoption of lupins into crop rotations. The spread of *mucuna* (velvetbean) in central America, and its extraordinary effect on maize yields, prompted World Neighbors to send 13 farmer promoters from Bolivia and Peru to Honduras. *Mucuna* does not grow above elevation of 2800 masl, and would have been destroyed by the process of mounding of soil around potatoes towards harvest. But lupin was identified by Milton Flores as an alternative – it can fix 200 kg N/ha/year, and benefits soils when turned under as a green manure. Farmers were at first incredulous, but their long association with the benefits of experimentation persuaded them to test the practice. Potato yields immediately increased from 1780 kg/ha to 8500 kg/ha with lupins, and rose to 13,000 kg/ha when sheep manure was also incorporated. The cash outlay for lupins is $18/ha, which compares with the $170/ha for an equivalent amount of inorganic fertilizer.

The project has seen many social benefits, not least improved household food security and health. Once yields improved, many farmers actually reduced their field size, sometimes by as much as 90%, so as to focus their intense efforts. Reduced field size turned out to have great benefits for women – making it easier for them to continue to farm whilst men migrate to cities in search of work.

Source: Ed Ruddell, Ruddell et al, 1999

3. Brazil: Microbacias (watersheds) and zero-tillage (ZT) programme in Santa Caterina

The state government extension and research service, EPAGRI (Empresa de Pesquisa Agropecuária e Difusâo de Technologia de Santa Catarina), works with farmers in the southern Brazilian State of Santa Catarina, from the flat coastal areas in the east to the rolling highlands and mountains of the centre and west. It is involved in working at a microwatershed level with local farmers to develop low-input and productive systems of agriculture. Each member of staff works in about four microwatersheds of about 150 families for a period of two years, playing an important social as well as technical role. Farmer experimentation is encouraged, and there is a large amount of decision-making at the level of these local extensionists.

The technological focus is on soil and water conservation at the microwatershed level using contour grass barriers, contour ploughing and green manures. Farmers use some inorganic fertilizers and herbicides, but there has been particular success with green manures and cover crops. Some 60 species have been tested with farmers, including both leguminous plants such as velvetbean, jackbean, lablab, cowpeas, many vetches and crotalarias, and non-legumes such as oats and turnips. For farmers, these involve no cash costs, except for the purchase of seed. These are intercropped or planted during fallow periods, and are used in cropping systems with maize, onions, cassava, wheat, grapes, tomatoes, soybeans, tobacco and orchards. Farmers use animal-drawn tools to knock over and cut up the green manure/ cover crop, leaving it on the surface. With another farmer-designed, animal-drawn instrument, they then clear a narrow furrow in the resulting mulch into which the next crop is planted. As a result, most farmers no longer plough.

The adoption of ZT in Santa Caterina is significant because farm structure is considerably smaller than in the neighbouring states of Paraná and Rio Grande do Sol (where hectarage under ZT has too seen extraordinary growth in the past decade). It is estimated that some 106,000 farmers have adopted ZT on about 880,000 hectares through the microbacias programme. There have been substantial improvements

in yields: maize up 47% over eight years (to 1999) to reach 3750 kg / ha, soya up 83%to 2730 kg / ha, and wheat up 82% to 2125 kg / ha.

Like other ZT programmes, EPAGRI has documented improvements to water quality, soil health and water retention. Soils are darker in colour, spongy to the step, moist and full of earthworms. The reduced need for most weeding and ploughing has meant great labour savings for small farmers. From this work, it has become clear that maintaining soil cover is more important in preventing erosion than terraces or conservation barriers. It is also considerably cheaper for farmers to sustain.

A highly significant component of the microbacias programme has seen the transformation of whole watersheds and the attention to social capital formation. In Santa Caterina, some 7700 groups have been formed in 559 microbacias, and these have become engaged in a wide range of activities. EPAGRI has also worked to involve local municipalities fully in the process of participatory technology development and extension, and now many municipalities employ their own agronomists to help in the process.

Sources: Rubens Altman, Alicides José Molinari, Hercilio de Freitas, Airton Spires, John Landers, Francis Shaxson; de Freitas, 1999; Landers, 1999

4. Brazil: Zero-Tillage in large scale farms in Paraná and Rio Grande de Sol

Zero- or No-Till (*plantio direto*) has seen extraordinary spread amongst some 200,000 farmers in the two southern states of Paraná and Rio Grande de Sol. These have been organised into 2100 microbacias in Paraná, and 455 in Rio Grande do Sol. The total area under ZT in 1999 was 10.5 million hectares – up from about 700,000 ha in 1990. These farmers are organised into some 8000 Friends of Land Clubs, which are organised at many different levels – local, municipal, multi-municipal, river basin and state.

The model of ZT is unlike that adopted in industrialised countries, particularly in the USA, as green manures, cover crops and legumes have been incorporated into rotations, so reducing the system's requirement for herbicides for weed control. The major on-farm impacts have been on crop yields, soil quality and moisture retention, and labour demand, and reduced fossil fuel use (a 40-70% drop). Maize yields have improved by 67% from 3 to 5 t / ha in a decade, and soya by 68% from 2.8 to 4.7 t / ha. A great deal of recent interest has focused on the substantial public benefit being produced by these farms through sequestration of carbon in organic matter in soils. This new carbon sink is helping to mitigate the drivers of climate change.

The key conceptual change in these ZT programmes has been the transition from soil conservation thinking (based on physical conservation measures) to soil restoration and improvement (based on biological measures). Maintaining soil cover is much more important than preventing erosion through terraces or barriers. It is this that has led to benefits both for farmers and the wider environment. And as John Landers (1999) has put it: *"ZT has been a major factor in changing the top-down nature of crop services to farmers towards a participatory on-farm approach"*.

Sources: Maury Sade, Alicides José Molinari, Simon Hocombe, Francis Shaxson, John Landers, Christian Pieri; Lander, 1999

5. Brazil: Agroecological farming systems in Zona da Mata

This project works with about 200 farmers near a designated conservation area. A buffer zone incorporating five municipalities around the park has encouraged farmers to be aware of the local and national value of the resources. Through the use of a series of participatory methods, farmers have redesigned diverse farm systems to make the most of agro-ecological relationships for coffee cultivation, particularly centred on green manures, soil conservation and agroforestry practices. Five farmers unions have been incorporated into a regional association, and these focus on adding value through the processing of coffee beans, and direct sales to the market. These groups have also helped to improve annual fodder supplies to individual farmers.

Source: Anôr Fiorini

6. Colombia: Comité de Investigación Agrícola Local (CIAL) – in Colombia and seven other countries of Latin America

Many Latin American countries have reduced investments in agricultural research and extension, and so it is increasingly critical that research is decentralised and devolved to farmers themselves. The CIALs (or local agricultural research committees) are social and institutional mechanisms promoted by CIAT to develop and expand participatory and adaptive approaches to agricultural research, and to fill the gap left by the retreating state. Some 249 CIALs have been formed in eight countries: in Colombia, the CIAL programme has worked with 4000 farmers in about 50 communities. The aim is to improve agroecosystem productivity and health, extend the capacity of poor communities to solve agricultural problems, and take advantage of new economic opportunities.

All CIALs develop their own research topics, and so there is no common impact. The social learning and institutional process is, however, similar. CIALs incorporate four or more farmer researchers elected by their community to conduct experiments for the benefit of the all local farmers. Technical supervision is given by external technicians and agricultural scientists. Regional groupings of CIALs hold annual meetings to share findings, and increase cross-community interaction. As CIALs mature, so does the generalised social capital in communities at large. Many CIALs invest in wider community activities, such as basic milling equipment, or in rotating credit funds. There have been many improvements to yields – maize typically up from 820 kg/ha to 1400 kg/ha following adoption of agroecological approaches.

In communities with CIALs, some 30% of households suffer food shortages during August-September, whereas 50-65% are insecure in communities without CIALs. The greatest benefits appear to be for the poorest households. A wide range of different technologies have been developed, including rearing of guinea pigs, reintroduction of wheat cultivation, live barriers, IPM in potatoes, organically-produced sugar patties, agroforestry, use of green manures, mulches, and the establishment of small food enterprises. There are many important challenges, not least in finding ways to ensure that groups are able to mature and develop, rather than fall away after initial successes.

Source: Ann Braun; Braun, 2000

7. Cuba: national policy for sustainable agriculture

One of the most remarkable coordinated policy efforts on sustainable agriculture has occurred in Cuba. Up to 1990, Cuba's agricultural and food sector was heavily dependent on external support from the soviet bloc. It imported 100% of wheat, 90% of beans, 57% of all calories consumed, 94% of fertilizer, 82% of pesticides and 97% of animal feed. It was also paid three times the world price for its sugar. At this time, Cuba also had the most scientists per head of population in Latin America, the most tractors per hectare, the second highest grain yields, the greatest increase in per capita food production in the 1980s, the lowest infant mortality, the highest number of doctors per head population, the highest secondary school enrolment and lowest teacher: pupil ratios.

But in 1990, trade with the soviet bloc collapsed, leading to severe shortages in all imported goods. Within two years, petroleum imports fell to half of the pre-1990 level, fertilizers to a quarter, pesticides to a third, and food imports to less than half. The government response was to declare an "Alternative Model" as the official policy – an agriculture that focuses on resource-conserving technologies that substitute local knowledge, skills and resources for the imported inputs. It also emphasises the diversification of agriculture; the breeding of oxen to replace tractors; the use of IPM to replace pesticides; the introduction of new practices in science; the need for widespread training; the promotion of better cooperation among farmers both within and between communities; and reversal of the rural

exodus by encouraging people to remain in rural areas.

The impact of the new policy has already been remarkable. Some 220 village-based and artisanal Centres for the Reproduction of Entomophages and Entomopathogens have been established for biopesticide manufacture. They produce 1300 t/year of *Bacillus thuriengiensis* sprays (used to control lepidoptera), 780 t/year of *Beaveria* sprays (for controlling beetles), 200 tonnes of *Verticillium* (for whitefly control) and 2800 tonnes of Trichoderma (a natural enemy). Many biological control methods are proving more efficient than pesticides. The use of cut banana stems baited with honey to attract ants, which are then placed in sweet potato fields, has controlled sweet potato weevil. There are 173 vermicompost centres, the annual production of which grew from 3000 to 93,000 tonnes. Crop rotations, green manuring, intercropping and soil conservation have all been incorporated into polyculture farming: cassava-beans-maize, cassava-tomato-maize, and sweet potato-maize have all been shown to be 1.5-2.8 times more productive than the sum of the individual monocultures.
Two important strands to sustainable agriculture in Cuba have emerged:

i) intensive organic gardens in urban areas of three types – self-provisioning gardens in schools and workplaces (*autoconsumos*), raised container-bed gardens (*organoponicos*), and intensive community gardens (*huertos intensivos*);
ii) sustainable agriculture on both large and small farms in rural areas.

Both have made a significant contribution to total food production (urban areas are defined as all farming within municipal boundaries and all agriculture within 3 km of population centres above 2000 people). In 1994, for example, *organoponicos*, *autoconsumos* and *huertos intensivos* were producing some 4200 tonnes of food per year. By 1999, this had grown to 727,000 tonnes. Both the number of gardens and per area productivity has increased. There are now some 7080 gardens (up from 2500 in 1997), and productivity has grown from 1.6 kg/m^2 (1994) to 19.6 kg/m^2. It is difficult to say how many farms are now devoted to sustainable agriculture practices – estimates suggest some 200,000 farms on about 150,000 hectares. For the *organoponicos*, an estimated 26,000 people are involved in direct food production.

One measure of effectiveness of sustainable agriculture to produce the necessary food is the aggregate data on calorific intake. This was 2600 kcal/day in 1990, fell to some 1000-1500/day soon after the transition (with severe food insecurity), and has risen to an average of 2700 kcal/day by the end of the 1990s.

At the forefront of the transition towards sustainable agriculture has been the Grupo de Agricultura Organica (formerly known as the Asociación Cubanes Agricultural Organica, and formed in 1993). GAO beings together farmers, field managers, field experts, researchers and government officials to help convince farmers that organic-based alternatives can produce sufficient food for Cubans. There remain many difficulties though: i) proving the success of an alternative system to sceptical farmers, scientists and policy-makers; ii) developing new technologies sufficiently quickly to meet emerging problems; iii) coordinating the many actors to work together; iv) the need for continued decentralisation of food production to farmer level, and the appropriate land reform to encourage local investment in natural asset-building; v) encouraging farmers of large scale rice, potato, sugar cane and citrus to reduce their use of pesticides and fertilizers.

Sources: Rosset, 1997, 1998; Murphy, 1999

8. Dominican Republic: Plan Sierra soil conservation

The Plan Sierra ecodevelopment project took on the challenge of breaking the link between rural poverty and environmental degradation in the central cordillera of the Dominican Republic. The strategy consisted of developing alternative production systems for the highly erosive systems used by local farmers. Controlling erosion in the Sierra is not only important for the betterment of the life of these farmers but also represents hydroelectric potential as well as an additional 50,000 hectares of irrigated

land in the downstream Cibao valley.

The main goal of Plan Sierra was the development and diffusion of production systems that provided sustainable yields without degrading the soil thus ensuring the farmers' productivity and food self-sufficiency. More specifically, the objectives were to allow farmers to more efficiently use local resources such as soil moisture and nutrients, crop and animal residue, natural vegetation, genetic diversity, and family labour. In this way it would be possible to satisfy basic family needs for food, firewood, construction materials, medicinals, and income. A range of farming methods are integrated in several ways: i) soil conservation practices such as terracing, minimum tillage, alley cropping, living barriers, and mulching; ii) use of leguminous trees and shrubs planted in alleys, for nitrogen fixation, biomass production, green manure, forage production, and sediment capture; iii) use of organic fertilizers based on the optimal use of plant and animal residues; iv) adequate combinations of polycultures and/or rotations planted in contour and optimal crop densities and planting dates; v) conservation and storage of water through mulching and water harvesting techniques. Animals, crops, trees, and/or shrubs are integrated to result in multiple benefits such as soil protection, diversified food production, firewood, improved soil fertility, and so on. More than 2000 farmers have adopted some of the improved practices.

Source: Miguel Altieri

9. Honduras, Guatemala and Nicaragua: Hillside improvement

Some 45,000 farm-families in Honduras and Guatemala have benefited from the adoption of sustainable agriculture, increasing crop yields from 400-600 kg/ha to 2000-2500 kg/ha. Farmers use green manures, cover crops, contour grass strips, in-row tillage, rock bunds and animal manures, which are finely-tuned through experimentation to local conditions. These programmes have regenerated local economies. Land prices and labour rates are higher inside the project areas, and families have moved back from capital cities. There are also benefits to the forests. Farmers say they no longer need to cut the forests, as they have the technologies to farm permanently the same piece of land. Throughout Central America, various NGOs have promoted the use of grain legumes, especially velvet bean *(Mucuna pruriens)* to be used as green manure, an inexpensive source of organic fertilizer to build up organic matter. Taking advantage of well established farmer-to-farmer networks, eg *campesino a campesino* movement in Nicaragua and elsewhere, the spread of this simple technology has occurred rapidly.

Source: Roland Bunch, Bunch 2000

10. Mexico: ISMAM fair-trade coffee

One example of an initiative that began at the local level and has received national recognition is one from Mexico. Indígenas de la Sierra Madre de Motozintla (ISMAM) is a Maya Indian Organic Coffee group in Chiapas. ISMAM was formed by smallholder coffee growers to meet problems of low productivity, poor marketing conditions and extreme poverty of farm families. By adopting organic techniques and improving quality, the coop was able to overcome soil degradation and low yields and move into a privileged speciality market that rewarded their extra efforts towards an ecologically sound production. Through sound, participatory management of the organisation and hard work, ISMAM was able to capitalise their enterprise, overcome initial government disinterest and repression to become a major agro-industry with their own processing facilities and direct export markets in the US, Europe and Japan.

They have begun to produce blends and soluble coffee for the national market and to diversify their agro-production for greater food security. Besides expanding their business, part of ISMAM's profits are returned to regional committees of the coop for investment in social works. In 1995 ISMAM received the National Agro-Export prize from the hands of Mexico's President. They now enjoy a privileged position with respect to credit and government support and have diversified their business into a number of areas including eco-tourism.

Source: Ronald Nigh

11. Mexico: UCIRI fair-trade and organic coffee

The Union of Indian Communities in the Isthmus Region was organised by farmers in Oaxaca for the cultivation and marketing of organic coffee. This was partly to reduce dependency on credit, but also to improve yields. Organic coffee cultivation demands more active management and a higher labour input from farmers. Coffee is planted on the contour to stop soil erosion, and slashed weeds and pruned branches are also laid on the contour. Half-moon terraces are constructed for each coffee tree. Formerly the coffee beans were depulped into waterways, causing significant water pollution - now farmers return the pulp to the fields after composting, along with animal manures, lime and green plant material. This improved system produces 600-1200 kg/ha of coffee beans, an improvement of 30-50% compared with earlier practices. The Union has 4800 members, and has been able to build up its own infrastructure for the transport, storage, processing, and export of coffee. The premium received for the organic coffee from fair trade organisations is used for a range of social purposes, especially improving schools. The Union also runs public transport and medical insurance systems, and owns several shops.

AFRICA

1. Benin: Mucuna (velvetbean) cover cropping

This is an example of the introduction of a simple regenerative component into farm systems combined with increasing farmers' capacity for local-adaptation of the technology. The spread of mucuna (*Mucuna pruriens*) for suppression of the aggressive weed imperata (*Imperata cylindrica*) has occurred because of land scarcity, decline in soil fertility, lack of fertilizer, and weed encroachment. Soils on the plateaux of southern Benin and Togo are nearing exhaustion. Fertilizer use is low among the large class of smallholder farmers. But even if fertilizers were available, the benefit from their use is declining because of a degrading soil resource base. Another consequence of the reduced fallow periods is encroachment of imperata, an aggressive weed that is very difficult to eradicate by hand. Researchers with the Recherche Appliquee en Milieu Reel project introduced mucuna cover cropping to alleviate the constraint of low nutrient supply to maize, the staple crop.

The government extension services (Centre d'Action Regional pour le Developpement Rural - CARDER) became interested in this success and started testing the system. In 1990, the CARDER for Mono Province tested the system in 12 villages with 180 farmers. They expanded to other southern provinces in 1991 and the number of farmers testing mucuna grew to approximately 500. Large NGOs became involved and some 14,000 farmers now growing mucuna throughout Benin.

Farmers who adopted mucuna cover cropping benefited from higher yields of maize with less labour input for weeding: maize following mucuna yields 3-4 t/ha without application of nitrogen fertilizer (similar to yields normally obtained with recommended levels of fertilization at 130 kg N/ha); whilst yields on plots previously planted with maize and cowpea was 1.3 t/ha. Mucuna as an intercrop or as a sole crop provides more than 100 kg N/ha to the following maize.

The benefit:cost analysis over a period of 8 years indicated a ratio of 1.24 when mucuna was included in the system, and 0.62 for the system without mucuna. The ratio was as high as 3.56 if mucuna seeds were sold. However, yearly analysis of the benefit: cost ratio indicated a declining trend over time for all systems suggesting that addition of external inputs (probably P and K fertilizer) are required in order to achieve full sustainability. Adoption of mucuna throughout the Mono Province would result in savings of about 6.5 million kg of nitrogen or about US $1.85 million/year.

Source: Bob Carsky, Victor Manyong

2. Burkina Faso: Soil and Water Conservation

Abandoned and degraded lands in dryland Burkina Faso have been improved with the adoption of tassas and zaï: 20-30 cm holes dug in soils that have been sealed by a thin surface layer hardened by wind and water action. The holes are filled with manure, which improve organic matter, promotes termite activity, and enhances infiltration. When it rains, the holes fill with water and millet or sorghum is planted. Tassas are normally used in conjunction with stone bunds.

In Burkina Faso, some 100,000 hectares have been restored – each producing some 700-1000 kg of cereal per year. Yields of millet without tassas, demi-lunes and contour stone bunds are 150-300 kg/ha; they rise to 400 kg with manure in a poor rainfall year, and 700-1000 kg/ha in a good rain year. Reij (1996) indicates that the average family in Burkina Faso using these technologies have shifted from being in annual cereal deficit amounting to 644 kg (equivalent to 6.5 months of food shortage) to producing a surplus of 153 kg per year. Tassas are best suited to landholdings where family labour is available, or where farm hands can be hired. The technique has spawned a network of young day labourers who have mastered this technique and, rather than migrating, they go from village to village to satisfy farmers' growing demands.

Source: Alberta Mascaretti, Chris Reij

3. Ethiopia: Cheha Integrated Rural Development Project

This is an example of an integrated and relatively small-scale project making a substantial impact on regional food security. It has been working in south-west Ethiopia since the drought of 1984, and has introduced of new varieties of crops (vegetables) and trees (fruit and forest), promoted organic manures for soil fertility and botanicals for pest control, and introduced veterinary services. Some 12,500 farm households have adopted sustainable agriculture on about 5000 ha, resulting in a 70% improvement of overall nutrition levels within the project area, along with a 60% increase in crop yields. Some farmers have begun to produce excess crops which they sell in local markets, earning much needed income for their families. Thus an area once reliant entirely on emergency food aid has now become able to feed itself and have enough left over to contribute to surplus. The real promise of the programme, however, lies in the fact that farmers are replicating activities on their own initiative (including those outside the project area), where once they had to be encouraged to participate through food for work payments.

Source: Food for the Hungry International

4. Kenya: Association for Better Land Husbandry

The ABLH is supported by the UK Department for International Development and promotes business development through low cost methods of conservation-based farming that reduce poverty, improve rural people's livelihoods and boost rural economies. It works on the premise that systems of sustainable and productive land use can be developed largely with the existing skills, knowledge and social organisation of rural people. It facilitates the formation of self-help groups of farmers, promotes sustainable agriculture technologies to these groups, helps them to market the outputs, and helping them to find ways to process and pack produce so as to retain greater added-value. It is engaged in business development, supporting community factories, and developing certification schemes and farmers' own brands to give produce better returns in local and national markets.

The approach to sustainable agriculture is called `near nil investment'. The basic principle is that poor rural families do not have the financial resources to invest in farm improvements. What they need are ways to boost productivity and income by making the best use of available human and natural resources. The technologies proven to work are concerned with the regeneration and recycling or organic matter for soil management, and the use of natural pesticides such as neem. The aim is to find ways to maximise returns from these technologies, and then `top-up' with externally-sourced fertilizers and pesticides where necessary and safe. Other low-investment resource-conserving technologies and practices are also made available to farmers, including beekeeping and agro-forestry. Most activities are currently focused on homegardens, though progress is also being made with field crops such as soya and sunflower.

Double dug beds combined with composting, green and animal manures improve the soil. A considerable investment in labour is required, but the better water holding capacity and higher organic matter means that these beds are more productive, more diverse and are able to sustain vegetable growth long into the dry season. Once this investment is made, little more has to be done for the next 4 to 6 seasons (2-3 years). Many vegetable and fruit crops are cultivated, including sukumawiki and other kales, onions, tomatoes, cabbage, passion fruit, pigeon peas, spinach, peppers, green beans and soya.

Self-help groups have found that their family food security has improved substantially since adopting conservation farming. Before, they had to use cash when they were short of food in the dry season to pay for maize and vegetables. They had to sell their labour, rely on remittances from family members working elsewhere in the country, or sell cash crops. They would have to do this at a time when food prices were high and labour and cash crop prices low. Many also relied on collecting wild foods from forests. But now, families have found that by working more on their own farms rather than selling labour to others, they are getting greater returns. They have found that investment on their own farms in natural capital pays better returns in food production. Casual hiring out of labour has virtually disappeared among SHG members. Children have been beneficiaries, as their health has improved through increased vegetable consumption and longer periods of available food. According to one review of 26 communities in eight Districts, 75% of households are now free from hunger during the year, and

the proportion of households buying vegetables has fallen from 85% to 11%.

Source: Jim Cheatle, Jules Pretty; Pretty, 1997, 2000

5. Kenya: Community mobilisation against desertification (C-MAD) programme

The C-MAD programme works in a `low-potential' part of South Nyanza, western Kenya. The programme area has a single rainfall season, and the land is badly degraded due to overgrazing and deforestation. The project began as a straightforward tree-planting effort, expanded to incorporate soil conservation, soil fertility and organic farming methods, and now focuses on whole farm improvements. The social processes incorporate participatory learning methods, farmer-based research groups, strengthening community and village groups, and collaboration with government and non-government research and extension agencies.

It works with about 500 farmers in some 1000 hectares, who have seen maize yields improve from about 2 to 4 t/ha. Income has also increased for many farmers following the cultivation of fruit (citrus, orange, mango, pineapple). The project reports increased local employment through growth in demand for on-farm labour. The cultivation of vegetables in home gardens has further improved domestic food security. The project also reports reduced child mortality and improved health and nutritional status.

Source: Peter Omondi, C-MAD

6. Kenya: *Vutu-sukumu* (Push-pull) pest management in smallholder systems

The work of ICIPE is explicitly focused on designing low-cost integrated pest management technology. It works closely with farmers to test and adapt technologies. It is also producing unexpected synergistic effects through manipulation of agricultural systems and the paradigms that define them. ICIPE approaches sustainable plant pest management on four major fronts:

- biological control, using one organism to control another;
- botanical agents, natural pest control compounds that are derived from plants;
- habitat management, manipulating the cultivated and natural environment to preserve the pest-natural enemy balance and richness of species;
- pest-tolerant varieties of major food crops that deter insect damage.

One activity is investigating novel habitat management approaches to suppress cereal stem borer and *Striga* populations in maize and sorghum. This project is developing novel 'push-pull' strategies to repel stem borers from the cereal crop and attract them to intercrop or barrier forage grasses. It has found extra-ordinary multi-functionality in a range of fodder grasses and legumes in cereal systems.

The strategy involves trapping pests on highly susceptible trap plants (pull) and driving them away from the crop using a repellent intercrop (push):

1. The forage grasses, *Pennisetum purpureum* (Napier grass) and *Sorghum vulgare sudanense* (Sudan grass), attract greater oviposition by stem borers than cultivated maize.

2. Non-host forage plants, *Melinis minutiflora* (molasses grass) and *Desmodium uncinatum* (silver leaf) repel female stalk borers (*Chilo spp).*

3. Intercropping with molasses grass (*Melinis minutiflora*) increases parasitism, particularly by the larval parasitoid, *Cotesia sesamiae*, and the pupal parasitoid *Dentichasmis busseolae. Melinis* contains several physiologically active compounds. Two of these inhibit oviposition (egg laying) in *Chilo*, even at low concentrations.

4. Molasses grass also emits a chemical, (*E*)-4,8-dimethyl-1,3,7-nonatriene, which summons the borers'

natural enemies.

5. Napier grass also has its own defence mechanism against crop borers: when the larvae enter the stem, the plant produces a gum-like substance kills the pest.

6. Sudan grass also increases the efficiency of the natural enemies (the parasitism rate on larvae of the spotted stemborer, *Chilo partellus* more than tripled, from 4.8% to 18.9% when the grass was planted around maize in a field and from 0.5% to 6.2% on *Busseola fusca*, another important pest).

7. ICIPE has found that intercropping maize with the fodder legumes *Desmodium uncinatum* (silver leaf) and *D. intortum* (green leaf) reduced infestation of parasitic weed, *Striga hermonthica* by a factor of 40 compared to maize monocrop. Reduction in S*triga* infestation by intercropping maize with the two species of *Desmodium* was significantly more than intercropping maize with soybean, sun hemp and cowpea.

Researchers from ICIPE and IACR-Rothamsted have found that such 'push-pull', using the attractive plants as trap crops and repellent plants as intercrops, reduces stem borer attack and increases levels of parasitism of borers on protected maize, resulting in a significant increase in yield. Farmer participatory trials in 1997 and 1998 have shown significant yield increases in maize. The aim is now to develop a maize-based cropping system that will reduce yield losses due to both stem borer and *Striga* and at the same time improve soil fertility due to nitrogen-fixing action of *Desmodium*. Such a redesigned and diverse system has many of the characteristics of `traditional' farms in Kenya.

Further ICIPE research is showing the effectiveness of neem to control weevils in bananas, diamondback moth in brassicas, and fruitborers in tomatoes; is developing resistant cultivars based on traditional germplasm; is showing the value of sterile male release for fruit fly control; and is demonstrating control of the stemborer, *Chilo partellus,* through identification of a natural enemy from Pakistan, the parasitic wasp *Cotesia flavipes* (Chilo was accidentally introduced from Asia in the 1930s, and has no co-evolved local natural enemies), which has now been released in Kenya, Mozambique, Uganda, Zambia and Somalia.

Sources: Hans Herren, John Pickett, ICIPE annual reports; Pickett, 1999; Khan et al, 2000

7. Kenya: Ministry of Agriculture soil and water conservation

Kenya has a long history of state intervention in both soil and water conservation and land management. Early approaches focused on providing cash payments to encourage farmers to construct the labour-intensive measures such as cut-off drains and artificial waterways. But by the end of the 1980s, it had become clear that the conventional approach to soil and water conservation was unable to meet the prevailing environmental challenge.

The Government of Kenya recognised that the only way to achieve widespread conservation coverage was to mobilise people to embrace soil and water conserving practices on their own terms. All financial subsidies were stopped, and resources allocated instead to participatory processes, extension, training, tools and farmer trips. It adopted in 1989 the Catchment (or Area of Concentration) Approach. This is seen as a way of concentrating resources and efforts within a specified catchment (typically 200-500 hectares) for a limited period of time (generally one year), during which all farms are laid out and conserved with full community participation. Small adjustments and maintenance would then carried out by the community members themselves with the support of local extension agents.

Participatory methods imply shifts of initiative, responsibility and action to rural people themselves. Interdisciplinary teams drawn from various government departments work for about a week in the catchment. These teams often include officers from MALDM, as well as those from other departments and ministries, including Education, Environment, Fisheries, Forestry, Public Works, Water Development, and Health. They sometimes include staff of local and international NGOs who are

actively working in the catchment. Following the Rapid Catchment Analysis phase, a Catchment Conservation Committee of farmers is elected as the institution responsible for co-ordinating local activities. A Catchment Report is prepared, which serves as a baseline document for planning, implementation, monitoring and evaluation, and for co-ordinated action by extension professionals based at Divisional and District level.

The Catchment Approach brings significant benefits over the individual farmer approach. The number of farms fully conserved each year in Kenya with various SWC measures has risen with the Catchment Approach from 59,450 (with doubts about sustainability) in 1988 to some 100,000 in the mid-1990s.

The process of implementation of the Catchment Approach itself has varied according to the human resources available and differing interpretations of the degree of participation necessary to mobilize the catchment community (Pretty et al, 1995). The impacts vary according to the quality of the interaction between extension staff and local people. When participation in planning and implementation is interactive, the impacts are substantially greater than when participation is simply consultative.

In an interactively planned catchment, an interdepartmental participatory rural appraisal is conducted to launch the catchment, which includes a *baraza* for presenting back findings and developing joint plans. The catchment committee is freely elected, and includes both men and women. After the catchment has been completed, the committees tend to remain active and committed to maintenance and replication. In conventionally planned catchments, the *baraza* is held mainly for publicity purposes, the catchment committees are more frequently selected by local leaders, and women rarely participate. The committees tend to become inactive soon after intensive contact with extension staff ends.

Sources: J K Kiara, Jules Pretty pers. observation, MoA/MoALDM annual reports 1989-1999; Pretty et al, 1995

8. Kenya: Mumias Education for Empowerment Project

The MEFE project works with some 2070 households in Kakamega, and area of western Kenya characterised by high rates of rural malnutrition, infant mortality and non-literacy. Severe food insecurity affected 1 in 4 people before the project, with many households only food secure for 1-3 months per year.

The project uses a structured learning process (REFLECT) to encourage all groups to analyse critically their own environment and to seek new solutions based on locally-available resources. The project uses a range of integrated pest management methods together with legumes, cover crops and green manures for soil fertility improvement. Raised beds have been incorporated on farms to increase vegetable production. As a result, beans and groundnut yields have doubled from 300 to 600 kg/ha. The project reports that the food security period has improved to 3-6 months for a typical household. The increased consumption of protein particularly benefits child health.

Source: Francisca Mate, James Atema

9. Kenya: Adaptive research programme, Environmental Action Team (EAT)

The EAT is a small on-farm research project based in Kitale in western Kenya, working with 130 farmers on about 80 hectares. In this area of Trans-Nzoia, food insecurity is widespread amongst small-holders. Farmers typically plant whole 0.5-1 hectare farms with maize, usually intercropped with beans. They use late maturing hybrids, which remain in the ground for 8-9 months. But due to low soil fertility, and farmers' inability to purchase fertilizers, yields are only 650-1750 kg/ha. The yields of the main source of household protein, beans, are also very low, mainly die to pests and diseases (especially root rot and bean fly) and low soil fertility. This leads to protein malnutrition amongst poorest households.

EAT seeks to address these problems through participatory research and training. Farmers are trained in the principles and practice of biological agriculture, with a particular focus on soil health. New

technologies are tested on farm, adapted, and then spread by farmers to neighbours if they work. The project helps farmers form groups –mostly it is women who come together first, and men who are attracted once the dramatic changes in productivity have been achieved.

A variety of technologies and practices have been adopted to improve household food production. These include: i) legumes and green manures - eg relay cropping of lablab into maize after 120-140 days – the legume takes over the land during the dry season, and the legume and maize residues are incorporated into the soil after harvest; and ii) composts and farmyard manure, with or without diammonium phosphate fertilizers, Tithonia and Sesbania. As a result, maize yields have improved to 3300-5500 kg/ha, and bean yields 4-8 fold. Further research is focusing on the trade-offs of harvesting legume grain and/or leaves compared with retaining all the green manure residues for the soil. EAT also promotes crop diversification with finger millet, soyabean, groundnut, pigeon pea and Irish potatoes, as well training farmers in intensive organic vegetable production in raised beds in home gardens.

Source: Beth Kirungu, Joseph Mureithi

10. Lesotho: Machobane Farming System

The Machobane Farming System is an example of a fundamentally redesigned system yielding multi-functional benefits. Lesotho is severely affected by erosion and land degradation. During the last twenty years, arable land fell 14 to 9% of the country's total area, and crop yields are now about half the 1970s level. Dr. J.J.Machobane, a Mosotho agronomist, first conceived his system over 40 years ago, experimenting on his own land for 13 years before attempting to launch it amongst fellow farmers. Unlike most extension methods, the Machobane approach starts with the basic behavioural requirements for adopting its technical message:

- self-reliance - farmers must be convinced that they can achieve food security without external assistance;
- appreciation of the resource base - farmers must be ready to work hard, and be convinced that they can improve crop production by fully exploiting their resource base;
- learning and teaching by doing - farmers must be trained on their own fields and farmer trainers must be ready to do work along with them;
- spontaneous technology spreading - farmers learn from other farmers, and Machobane farmers have the duty to help their neighbours.

In Lesotho mountain areas, most crops are grown on terraced land, but poor soil structure, inadequate soil fertility management and erratic rainfall, mean that land productivity is low and variable. According to Machobane, these constraints can be overcome by rational exploitation of the resource base and minimising the need for purchased inputs. The technical elements include intercropping, localised placement of ash (from household waste) and manure, weeding, introduction of potato as a cash crop, preservation of natural enemies, row-rotations, and legumes with cereals.

Farmers adopting the MFS indicate three advantages of the system: (i) higher land productivity (0.4 ha per family needed for food security compared with the more normal 1.2 ha); (ii) large cash income obtained by planting potato; and (iii) better resistance to drought: their fields are green compared to non-Machobane fields during drought. In addition, MFS will substantially reduce farm income fluctuations through the combination of lowering yield fluctuations of individual crops, spreading risk of fluctuations in yields and prices by planting a larger range of crops and decreased reliance on imported inputs (fertilizers and pesticides). Some 2000 farmers are now practising this system.

Source: Alberta Mascaretti

11. Madagascar: System of rice intensification (SRI)

The System of Rice Intensification (SRI) was first developed in Madagascar by Fr. Henri de Laudanié in the 1980s, has been promoted since 1990 by the Association Tefy Saina, and evaluated by the Cornell International Institute for Food, Agriculture and Development. The system has improved rice yields from some 2 t/ha to 5, 10 or even 15 t/ha on farmers' fields. This has been achieved without having to use purchased inputs of pesticides or fertilizers. The SRI is centred on making best use of the existing genetic potential of rice by breaking many of the conventional `rules' of management:

i) Rice seedlings are usually transplanted at about 30 days (sometimes as late as 40-50). In the SRI, seedlings are transplanted at 8-12 days. This increases tillering – with SRI plants typically having 50-80 tillers compared with 5-20 for conventional ones.

ii) Rice seedlings are usually planted close together to minimise weed infestation. But in the SRI, they are planted at least 25 cm apart in a grid pattern rather than rows. This facilitates mechanical weeding, as well as reducing seed use from 100 kg/ha to about 7 kg/ha. Wider spaced plants develop a different architecture, with more room for roots and tillers. Better root systems means reduced lodging.

iii) Most scientists and farmers believe that rice, as an aquatic plant, grows best in standing water. In the SRI, however, paddies are kept unflooded during the period of vegetative growth. Water is only applied to keep the soil moist, which is allowed to dry out for periofds of 3-6 days. Only after flowering are paddies flooded, which are then drained 25 days before harvest (as for conventional rice). Such management encourages more root growth.

iv) Flooding is the conventional approach to weed control. With SRI, farmers must weed up to four times – mechanically or by hand. Farmers who do not weed still get respectable yield increases of 2-3 fold; but those that weed get increases of 4-6 fold.

v) SRI farmers use compost rather than inorganic fertilizers

The improvement in rice yields with SRI have been so extraordinary that, until lately, they have been simply ignored by scientists. SRI challenges so many of the basic principles of irrigated rice cultivation, and so many professionals have been entirely sceptical. But it is the number of farmers adopting SRI that is proof of its effectiveness and efficiency.

It is estimated that some 20,000 farmers have now adopted the full SRI in Madagascar (Tefy Saina estimates that 50-100,000 farmers are now experimenting with elements of the system). Cornell have helped research institutions in China, Indonesia, Philippines, Cambodia, Nepal, Cote d'Ivoire, Sri Lanka, Cuba, Sierra Leone and Bangladesh locally to test SRI. In all cases, rice yields increased several fold. In China, for example, yields of 9-10.5 t/ha were achieved in the first year (compared with a national average of 6t/ha).

Sources: Norman Uphoff; Uphoff, 2000a, b

12. Malawi: small scale aquaculture

The International Center for Living Aquatic Resources Management (ICLARM) works to integrate pond fish culture into low input farm systems in Malawi. The programme uses a participatory process for farmers and scientists jointly to map resource flows on farms, and then identify the potential for adjustments that would bring synergistic effects. It has worked with some 2000 individual farmers on both vegetable improvements in home gardens and fish-pond aquaculture. This integrated agriculture-aquaculture component of farmers often comprises only 500 m² within an average farm size of 1.5 hectares. Yet intensification of just this core component has led to significant improvements in food security – vegetable yields have grown to 2700 to 4000 kg/ha, and fish ponds produce the equivalent of 1500 kg/ha of fish – a new source of food for households. These integrated farms also produce six times more cash than conventional farms - with the vegetable-fish element contributing up to 70% of annual cash income.

ICLARM has documented the steady improvement of productivity in these systems amongst collaborating farmers – with pond productivity increasing steadily from 800 to 1500 kg/ha. Amongst those farmers trained only through the conventional Training and Visit system in southern Malawi, yields by contrast fall steadily, as the over-designed systems unravelled as farmers lost control. An asset-building approach, building both on natural capital on the farm and farmers own human capital (skills and knowledge) allows for continuous readjustments over time.

Source: Randall Brummet, Daniel Jama; Brummet, 2000

13. Malawi: Agroforestry Extension project (MAFE)

This participatory extension project work with some 20,000 farmers on 4200 hectares to encourage the adoption of various agroforestry practices within farms. These include i) undersowing of *Tephrosia vogelii*, pigeon pea and *Sesbania sesban* in maize for soil fertility improvement; ii) dispersed tree interplanting (eg *Faidherbia, Acacia polycantha. A. galpinii*); and iii) soil and water conservation practices, especially contour grass hedges.

The project uses participatory approaches to bring a wide range of government and non-government organisations together with farmers to ensure that these technologies are well-adapted to local conditions. Farmers are formed into farmer associations, which can then draw down on these external bodies for specific services. The project has trained farmer trainees, who pass on their expertise to colleagues. As a result of these social process and new technologies, maize yields have improved from 700 kg/ha to 1500-2000 kg/ha. Farmers have become less dependent on fertilizers (many of which are too expensive for smallholders), and the project reports more households becoming both food and woodfuel secure. Some 6.98 million trees were planted in 1999 by 1155,913 households, and the project expects to see reduced pressure on natural forests as these mature.

Source: Zwide Jere, MAFE project

14. Niger: Soil and water conservation

The IFAD-funded soil and water conservation in Illéla district is an example of a key sustainable agriculture technology having substantial multi-functional benefits whilst improving formerly degraded or abandoned lands. Some 5800 ha of abandoned and degraded lands on the farms of some 6000 households in 77 villages have been improved with the adoption of tassas (also known as zaï in Burkina Faso). Large-scale erosion control measures were not successful in the region.

Tassas are 20-30 cm holes dug in soils that have been sealed by a thin surface layer hardened by wind and water action. Since this crust prevents infiltration by water, these areas are usually abandoned, devoid of vegetation, scattered with outcroppings of iron crust, and are prime sites for surface erosion. The holes are filled with manure, since soils in this region are normally lacking in organic matter. This also helps to promote termite activity during the dry season, so further enhancing infiltration. When it rains, the holes fill with water and farmers then plant millet or sorghum. Tassas are normally used in conjunction with stone bunds, taking advantage of the stones that farmers remove from fields for planting. These methods of soil and water conservation were learned by farmers of Illéla on a visit to Yatenga in Burkina Faso where, on the central plateau alone, some 100,000 hectares have been restored – each now producing some 700-1000 kg of cereal per year. According to Hassan (1996), yields of millet without tassas, demi-lunes and contour stone bunds are of the order of 150-300 kg/ha. They rise to 400 kg with manure in a poor rainfall year, and 700-1000 kg/ha in a good rain year. Addition of some fertilizer increases yields again – to 650 kg/ha in poor years and 1400-1500 kg/ha in good ones.

This soil-development activity has allowed the region to attain average millet yields of 480 kg/ha, reaching levels of up to 700 kg/ha if chemical fertilizer is added (an as-yet uncommon practice).

Comparatively, fields of similar quality levels produced only 130 kg/ha According to IFAD, food availability in participating households rose between 20% and 40%, depending on local rainfall conditions. Reij (1996) indicates that the average family in Burkina Faso and Niger using these sustainable agriculture technologies have shifted from being in annual cereal deficit amounting to 644 kg (equivalent to 6.5 months of food shortage) to producing a surplus of 153 kg per year.

Tassas are best suited to landholdings where family labour is available, or where farm hands can be hired. The technique has spawned a network of young day labourers who have mastered this technique and, rather than migrating, they go from village to village to satisfy farmers' growing demands. There are cases of land being bought back by farmers who recognized early on the profit that can be earned from this land.

Three key factors have contributed to the development and dissemination of this technology in the farming community:

- An action-research approach that combines flexibility, openness to farmer initiatives, a forward-looking attitude and willingness to negotiate;
- A technology that combines the core benefits of innovation: immediate results, simplicity, ability to be integrated into existing cropping systems, and replicability
- A technological package that can adjust to the changing local context.

Sources: Alberta Mascaretti, FAO; Reij, 1996; Hassan, 1996

15. Senegal: Rodale Regenerative Agriculture Research Center

In Sahelian countries, the major constraints to food production are related to soils, most of which are sandy and low in organic matter. Where they are heavier and better in quality, they are subject to intensive use and so exposed to erosion by water and wind. In Senegal, soil erosion and degradation threaten large areas of agricultural land. Since 1987, the Rodale Institute Regenerative Agriculture Research Center has worked closely with farmers associations and government researchers to improve the quality of soils in Senegal by using agroecological methods.

Regenerative agriculture in the peanut basin has resulted in positive biophysical, environmental, social and economic benefits. The primary cropping system of the region is a millet-groundnut rotation. Fields are cleared by burning, and then cultivated with shallow tillage using animals. But fallow periods have decreased dramatically, and the use of inorganic fertilizers and pesticides is rare amongst smallholders, owing to high prices. It has also been well-established that inorganic fertilizers do not return expected yields unless there is concurrent improvements in organic matter – nutrients are washed away by the first rains, or are taken up by soil microbes and weeds. Soils low in organic matter also do not retain moisture well.

The RARC works with about 2000 farmers in 59 groups to improve the soil quality, integrate stall-fed livestock into crop systems, add legumes and green manures, improve the use of manures and rock phosphate, incorporate water harvesting systems, and develop effective composting systems. The result has been a 75-195% improvement in millet yields – from 330 to 600-1000 kg/ha, and in groundnut yields from 340 to 600-900 kg/ha. Yields are also less variable year on year, with consequent improvements in household food security. As Amadou Diop has put it: *"crop yields are ultimately uncoupled from annual rainfall amounts. Droughts, while having a negative effect on yields, do not result in total crop failure"*.

Sources: Amadou Diop; Diop, 2000

16. Uganda: household livestock development

Heifer Project International introduced zero-grazing of dairy production to Uganda. This involves keeping good quality dairy cows in confinement and cut and carry feeding. The system includes

production of forages, grasses and leguminous trees. Much of these are grown on bunds and intercropped with food or cash crops thus conserving soil and moisture. The system also results in greater food security and better family nutrition. Animals are a good source of income and food in the dry season and ruminants can use much to the crop and food processing by-products. The gathering of manure and compost from the zero-grazing unit, provides an ongoing source of organic fertiliser and provides for the rapid recycling of limited nutrients within the system. The strengthening of community groups which provide mutual support and training is another significant component.

Dairy heifers are provided as an in-kind loan. Farmers repay the loan by raising a female offspring which is then "passed on" to another farmer in the community. Thus the group has a capital resource which also for the benefit of the program to continue to spread. The zero-grazing system was introduced to Uganda by HPI in 1983, and has survived despite political and economic problems. It has since been adopted by numerous agencies, including the Ministry of Agriculture and International NGOs.

Over 5,000 families have benefited directly from significant increase in income and nutrition, resulting in dramatic improvements in housing and school attendance. Some 10,000 hectares of land have been improved or stabilised by the development of a sustainable small-holder dairy farming system. Over 50 community-based groups have been strengthened and these are an engine for rural development. The status of women has been enhanced as over half of the livestock owners are women, many of who are widows with large families.

Source: Carolee Black

17. Zimbabwe: Chivi Food Security Project

This ITDG project is located in southern Zimbabwe, which falls into Zimbabwe's lowest categories of agricultural potential, and where drought occurs in three out of every five years. An approach which combined low-cost regenerative technologies with building farmers' capacities to participate in research, extension and within group structures has meant that now farmers report that their yields have more than doubled (up 100%) since the project was initiated in 1991. The main technologies are water harvesting (tied ridges and infiltration pits) and the adoption of clay pipes and ferro-cement rings for subsurface irrigation of women’s vegetable plots. Some 35 women’s garden clubs for raising and selling vegetables are now effective and families have become food secure with the greater range of produce spread through the year. According to some community participants *"food security is no longer a problem"*.

The multi-functional benefits of the project include farmers have acquired new skills for food production; local institutions have been strengthened in tackling their own problems; transformative training has increased confidence among local people, particularly poorest groups; increased involvement of women in community decision-making; greater capacity amongst farmers to articulate their needs to service providers, and research and extension systems have become more responsive to farmers’ needs.

Source: Intermediate Technology Development Group

ASIA

1. Bangladesh: Integrated pest management for rice

Integrated Pest Management for rice in Bangladesh is being implemented through three projects (INTERFISH, NOPEST and GOLDA) that are supported by DFID and the EU and implemented by Care. They involve farmers attending farmer field schools (`schools without walls’) during a whole rice season. They meet each week to learn new agro-ecological principles and concepts relating to rice, pest and predator management. Some 6000 farmer field schools have been completed, with about 150,000

farmers adopting more sustainable rice production on 54,000 ha. The programmes also emphasise fish cultivation in paddy, and vegetable cultivation on rice field dykes. Rice yields have improved by 5-7%, and costs of production have fallen owing to reduced pesticide use - some 80% of farmer field school participants no longer use pesticides. The fish-rice-vegetable systems have been shown to produce synergistic benefits: additional income from fish is $156/ha, from vegetables on dykes $23/ha, but fish and vegetables together bring an additional $250/ha. As a result, the 150,000 participating households are now food secure throughout the year.

Source: Desilles, 1999

2. China: Wheat-Maize Double Cropping Programme, Hebei Plain

The Wheat-Maize Double Cropping System project is located on Hebei Plain, northern China. It began in 1996 and is financially supported by the provincial government, Xinji County government, and the Science and Technology Committee of Hebei Province. After a successful field trials, the wheat-maize double cropping system was extended through model farms, videos and printed materials. Some 224,000 households have since adopted the technology on about 100,00 hectares. Yields have improved by about 10%, water use has been reduced by 30%, and fertilizer use reduced by 20%. As a result, net returns have improved by 30%.

Source: Liang Weili

3. China: fish in rice programme, Jiangshu Province

Rice-fish culture offers many benefits to rural households, economies and environments. At present, only 136,000 ha of the total area of 21 million ha of irrigated rice fields in South East Asia are used for aquaculture. Jiangsu province in China has more than 30 million mu (2 m ha) of rice fields, among which one third are suitable for rice-fish culture. The "The Extension Project of Large-scale, High-yielding, High-effective Techniques of Rice/Aquaculture in Jiangsu Province" project was developed by the provincial government in the mid-1990s, with multi-functional aims: to develop rice/aquaculture combined with reforming and ameliorating low-yielding paddies, ponds and waterlogging farmland for the purpose of increasing food production and income, promoting rural economy, and enriching farmers.

As a result, the rice aquaculture area in Jiangsu Province expanded from about 5000 ha in 1994 to reach 68,973 ha in 1997. In addition, the area of rice-crab culture expanded to 36,113 ha and rice-shrimp culture reached 13,867 ha. The economic returns of rice aquaculture are remarkable. In 1997 the unit profit of rice/aquaculture fields was 2.86 times that of mono rice cultivation in paddies. Rice-aquaculture systems are low cost, and provide rapid economic returns. They provide an additional source of food and income in rural areas, producing 50 kg of fish per mu.

Rice-aquaculture farming systems also maintain the ecological balance of rice field ecosystems. The rural environment can be improved through the use of non-pollution agriculture – the use of agricultural chemicals is greatly reduced. Rice-fish culture also helps eliminate mosquito larva harmful to human health. Japanese encephalitis and malaria are transmitted by mosquitoes found in a wide belt of Asia, and their prevention depends on improved environmental manipulation to stop mosquito breeding in rice fields. Rice-fish systems provide good control of mosquito incidence. In Quanzhou County, incidence of malaria fell from 11.6/100,000 to 0.1/100,000 as the area of rice-fish cultivation grew from zero to 43% over a ten year period.

Source: Li Kangmin, 1998

4. China: East Gansu Sustainable Agricultural Techniques for Effective Use of Rainfall Resources Project

The East Gansu region is part of the 51 million ha dryland area in the Northwest of China. This sustainable agriculture project was initiated by the Gansu Academy of Agriculture in 1991 as part of Ninth Five-year National Development Plan aimed at achieving food security and self-sufficiency. It promotes more efficient use of rainfall through run-off collection techniques, water storage tank construction, devices for lifting and conveying water, microcatchment water conservation with film mulching, and multiuse crop products and bi-products for livestock. The number of farm households adopting sustainable agriculture is now 100,000 on an area of some 70,000 ha. Cereal yields have increased substantially -wheat by 40% (from 3 to 4.2 t/ha), and spring maize by 38% (from 6 to 8.3 t/ha). There is greater availability of both irrigation water and drinking water for people and animals. Additional benefits include reduced soil erosion, decreased pesticide and fertilizer use, increased social capital formation through farmers' mutual aid groups, and increased capacity of women who now play a major part in fruit and vegetable management and livestock rearing.

Source: Fan Tinglu

5. India: Indo-German Watershed Development Programme, Maharashtra

The IGWDP is an integrated environmental regeneration programme implemented by village self-help groups in the drought-prone state of Maharashtra. It is assisted by the German development agency GTZ and development bank KfW, and administered by NABARD (the National Bank for Agriculture and Rural Development) and the locally Watershed Organisation Trust. The programme works in partnership with 51 local NGOs and 77 village self-help groups, and has seen sustainable agriculture implemented on some 92,000 hectares, with the involvement of about 20,000 farm households. There has been a marked improvement in agricultural productivity (dryland yields up 250%; milk production up) and natural resource productivity (wells wet for more months per year; increased fodder grass production), which in turn has increased incomes and food security (household grain production up 40-100%), reduced seasonal migration, increased school attendance, and a led to a wider sense of hope and confidence amongst rural people. Many new village institutions have also been organised by rural people, including grain banks, women's groups, youth groups, credit unions, dairy cooperatives, and agricultural cooperative societies.

Source: Lobo and Korchendorfer-Lucius, 1998; IGWDP, 1998

6. India: KRIBHCO Indo-British Rainfed Farming Project (West)

This participatory soil and water conservation project is supported by DFID and is based in upland areas of Gujarat, Rajasthan and Madhya Pradesh. Land degradation is severe, soils are poor, and agricultural production is usually inadequate to support most families. The project works with local groups of 15-25 households on water-harvesting, tree planting, and grazing land improvements. There are now 232 groups in 70 villages: funds raised by each group now average Rs 650, generated mostly from increased agricultural production (giving a total fund base of Rs 151,000). Basic grain yields (rice, wheat, pigeonpeas and sorghum) have improved from 400 kg/ha to 800-1000 kg/ha. The increased fodder grass production from the terrace bunds is also valued highly. The improved water retention (water tables have risen by 1 metre over the past 3-4 years) means that a *rabi* season crop is now possible for many farmers, turning an unproductive season into a productive one, resulting in a sharp decrease in seasonal out-migration.

Source: Smith, 1999

7. India: Government of Rajasthan Watershed Development Programme

The Watershed Development and Soil Conservation Department of the Government of Rajasthan was

set up in 1991 to implement a participatory approach for integrated watershed development. Since the 1940s, groundwater levels had fallen dramatically, forests had become degraded, and community institutions undermined. But despite considerable expenditure on soil conservation, the impacts were poor, as Krishna observed: *"field observations confirmed... near zero maintenance by the beneficiaries"*. The GoR recognised the need to involve local people, and has since facilitated the formation of 15,000 watershed users' groups, with at least three million hectares (possibly as high as 10-15 m ha) under sustainable practices. The technologies are low-cost and based on indigenous and biological technologies, including strips of vetiver and other grasses on the contour; contour bunds and contour cropping; field bunds; drainage line treatment; and regeneration of common lands with shrubs and trees. Sorghum and millet yields have more than doubled to 400-875 kg / ha (without addition of fertilizers); and grass strips have improved yields by 50-200% to 450-925 kg / ha.

Source: Source: Krishna et al, 1997; Uphoff et al, 1999; Krishna, 1999

8. India: The Society for People's Education and Economic Change, Tamil Nadu

SPEECH has been working in Kamarajar District of Tamil Nadu since 1986, and has helped to build and strengthen local groups and institutions in 45 villages. The region is known for its acute droughts, erratic monsoons, poor services and entrenched socio-economic and cultural division. Village groups, or *sanghas*, have adopted a range of sustainable agriculture approaches to make better use of existing resources. Water harvesting has been particularly effective, as it not only brings previously abandoned land into production, but also means sufficient water can be saved for an additional wet rice crop on the small amount of irrigated land. Milk cows have been introduced, bringing particular benefits to women and children. Sorghum and millet yields have doubled, and extra crops and fruit and timber trees are being cultivated. As *sanghas* become more confident, they begin to develop new activities, such as providing for health care, building roads, and running savings and credit schemes. Representatives are elected to a Cluster Level Governing Council, an independent society that provides a platform for local groups to address emerging concerns.

Source: John Devavaram; Devavaram et al, 1999

9. India: Water users' associations and participatory irrigation management in Gujarat

In July 1995, the government of Gujarat adopted a resolution announcing the participatory irrigation management (PIM) programme. It envisages a complete turnover of operation and maintenance of canals to water users associations (WUA). While the canals remain government property and major repairs continue to be the responsibility of the irrigation department, the responsibility of the day-to-day functioning of the system is of the WUA. Planning of crops, allocation of water available for irrigation, fixing the water rates, collecting the water demand forms and water charges from the individual members and disciplining the defaulters are the other responsibilities of the WUA under the PIM. After carrying out repair and rehabilitation, works on the canal network the management is to be `turned over' to the WUAs.

In the pilot phase of the PIM programme, thirteen projects were selected to experiment and learn from the new approach. This programme focuses on the formation of user cooperatives and the development of links between different actors (participant farmers, NGOs and government). The NGOs mobilize and organize farmers to set up a WUA and guide it during its formation and through subsequent stages. However, technical help, cooperation and guidance from the department remains an important link. The participating farmers form and manage the Association, they also make a fixed contribution toward the initial expenses of repair and rehabilitation of the system. It is generally understood and appreciated that the NGOs have been particularly adept at developing cooperative spirit among the participants.

The most outstanding results include:

- Peoples' participation grew gradually in the WUA, with strong emphasis on "Learning by Doing" (a concept that emerged during the process of implementation of the PIM);

- The higher (than government) water charges levied by the WUA underwent a series of negotiations proving empowerment of people, and at the same time water pricing to be dynamic and difficult process;
- The importance of motivation in a participatory programme, and the NGO's role in this;
- Phasing strategies of the process of implementation of the programme provided invaluable lessons for replication;
- The importance of taking in to account the dynamics of caste, class, inter and intra-village differences in the society while implementing a programme;
- The important and crucial role of documenting the process of implementation by a researcher - a parallel research effort was found to helpful in introducing mid-course corrections in the implementation of the programme.

Source: Anil Shah

10. India: National IPM Programme

Like a range of other Asian countries, the national IPM programme in India uses farmer field schools to build farmer capacity and knowledge on agroecology. Some 77,000 farmers have been trained in 2600 FFS on rice, cotton, sugarcane and oilseeds. A further 12,400 demonstrations have been conducted after FFSs to help spread the concepts and practice of IPM. FFS are also being used to address wider soil, water and nutrient management issues. In Tamil Nadu, for example, farmers are experimenting with row planting, planting distance, biofertilizers (*Azospirillum*, *Azolla*), organic manures and basal fertilizer applications. Farmers' adoption of biocontrol agents (eg *Trichogramma*, neem) means that conventional pesticide use has fallen by 50% on average. Incomes have increased by Rs 1000-1250 / ha, and rice yields have increased by 250 kg / ha.

Source: Eveleens et al, 1996

11. Indonesia: National Integrated Pest Management for Rice Programme

In 1986, a Presidential Decree banned 56 brands of pesticide on rice and established a national IPM programme, with the aim of making farmers experts in their own fields through the use of farmer field schools. One million farmers have now attended about 50,000 FFSs, the largest number in any Asian country. The programme is supported by FAO, the World Bank and USAID, and operates in 12 of the 26 provinces, including all 6 rice-bowl provinces. The impacts have been substantial: one survey of 2000 farmers found that rice yields had increased by 0.5 t / ha on average, with lower variation in year-on-year yields. At the same time, the number of pesticide applications had fallen from 2.9 to 1.1 per season, with dramatic reductions in the use of banned products. On average, a quarter of all farmers are now applying no pesticides, rising to a half in some villages. Many of the FFSs have continued to be active as farmer IPM groups, meeting to discuss farming problems; monitor pest and predator populations in their villages; conduct village wide campaigns to control rats, extend IPM to neighbouring villages; and run savings and credit programmes.

Source: van der Fliert, 1993; Eveleens et al, 1996; Kenmore, 1999

12. Nepal: Jajarkot Permaculture Programme

This promotes sustainable food production in 31 villages of Jajarkot Khalanga, and is supported by ActionAid Nepal. A community-based process builds on the skills and knowledge of local people and professionals through social capital formation. The main impacts of the programme are increased food production – some 40% of the 580 participating households, organised into 44 groups, are now entirely food self-sufficient through increased used of regenerative agriculture technologies, including green manures, composting, intercropping, agro-forestry, and increased diversification of farm systems

through incorporation of fruit trees, bees, sheep, rabbits, cotton, flowers; and intensification of kitchen gardens. The programme also works with smokeless stoves, pit latrines, community groups for managing local savings and credit system, support to small businesses, strengthened adult education and access to health facilities.

Source: JPP, 1997-99; Chris Evans, pers. comm. 1999

13. Philippines: Contour Farming on Sloping Lands in Claveria

Claveria is in northern Mindanao, and is characterised by acid soils on sloping lands with severe erosion. ICRAF and local research and extension agencies worked with farmers on the development of a variety of contour farming technologies. The project began with leguminous trees, but after relatively weak uptake, developed more locally suited methods in the form of natural vegetative strips combined with ridge tillage. A wide range of perennial crops have been tested by the 2000 farmers working in the 80 local groups formed by the project, including fruits, coconut, mulberry and fast-growing timber species. On farms with soil improvement (some 6000 ha), maize yields have improved 15-25% and land values by 35-50%.

Source: Garrity, 1999; Fujisaka, 1999

14. Philippines: Integrated Pest Management for Highland Vegetables

The CABI Bioscience IPM for Highland Vegetables project was set up in 1994 and is funded by the Asian Development Bank. Insecticide resistance and human health problems had become severe, and so the IPM project set up farmer field schools to increase awareness about the harmful effects of pesticides, to increase knowledge of natural enemies, and to encourage discussion on best husbandry practice amongst farmers. The project reached 1719 farmers in 65 FFS groups, with 48 trainers trained, mainly from local government. As a result, a range of alternative pest control methods was developed by farmers. There has been an 80% decrease in pesticide use in the wet season (55% fall in the dry season) and the synthetic fertilizer rate has halved, giving farmers a net rise in income of 17%. Vegetable yields have also increased by about 20%. Farmer field schools are now considered locally to be a good investment by municipal authorities.

Source: Lim Guan Soon; Peter Ooi

15. Sri Lanka: National Integrated Pest and Crop Management Programme

The INTEGRATED project is an IPM extension programme working in a wide range of agro-ecological zones of Sri Lanka. It is implemented by Care International, with funding from the EU and DFID. The project uses farmer field schools to promote IPM, and has trained 4300 farmers in sustainable rice and vegetable production methods. Some 55,000 farm households on about 33,000 ha have now adopted sustainable agriculture, with substantial reductions in insecticide use (2.9 to 0.5 applications per season for rice). Yields have increased by 12-44% for rice, and 7-44% for vegetables, depending on location in the country.

Source: Jones, 1999

16. Sri Lanka: Gal Oya and Mahaweli Participatory Irrigation Schemes

The participatory approach to irrigation system rehabilitation was pioneered in the Gal Oya scheme, and had the effect of changing many professionals views about farmer involvement in water management. At the beginning of the project, Gal Oya was the largest and most run-down scheme in Sri

Lanka. The approach was founded on building local institutions for water management, taking groups through a process of problem identification and collective action, leading to formal organisation. Some 33,000 water users' associations (comprising at least 500,000 farmers on 0.5-1 million hectares) were formed in both Gal Oya and Mahaweli. The economic benefits arise mainly from increased water use efficiency, enabling farmers to increase cropping intensity and so raise total production. There were also some increases in rice yields. As farmers took control, so the number of complaints received by the Irrigation Department about water distribution fell to nearly zero. Since project completion, farmers' organisations have maintained themselves, progressed institutionally, and developed their own capacity for dealing with problems.

Sources: Uphoff, 1999; Wijayaratna and Uphoff, 1997

17. Vietnam: IPM in rice in Mekong Delta

Researchers with the International Rice Research Institute, Ministry of Agriculture and Rural Development (Vietnam) and Visayas State College of Agriculture (Philippines) have been engaged in the past eight years in a unique and successful initiative to encourage the adoption of more sustainable rice production in the Mekong Delta, Vietnam. Surveys in the early 1990s showed that insecticide use by farmers was high, particularly to control leaf-feeding larvae that caused visible defoliation. Farmers believed that such visible damage caused yield loss, but researchers had discovered that leaf-damage during the vegetative stages of rice rarely reduce yields. Indeed, use of insecticides was more likely to kill beneficial insects, and lead to outbreaks of secondary pests.

Through an innovative media campaign backed with farmer-field schools, farmers in Long Am Province were encourage to test the heuristic *"insecticide spraying for leaffolder control in the first 40 days after sowing is not needed"*. The campaign distributed 380,000 leaflets and 35,000 posters, organised 1390 demonstrations and broadcast a radio drama 1550 times. This reached 97% of the 20,000 farmers in the study region, and 82% of those on the whole province – a total of 172,000. In the two and a half years after the campaign, mean insecticide spraying fell from 3.35 to 1.56 sprays per farmer per season. Farmers' perceptions had changed substantially – 77% had stopped early season spraying, and 20-30% had stopped using insecticides altogether.

Other provinces in the Mekong Delta adopted the approach, and their campaigns have reached 92% of the 2.3 million farmers – who have now reduced spray frequencies to one per season (a 70% reduction). Rice yields have not changed during this period – remaining at about 4t/ha. Researchers concluded that the two interventions – detailed understanding from the farmer field schools, and spread through the media campaign, play complementary roles in changing both farmers' beliefs and practices. Researchers are now exploring ways to develop targeted advice for other phases in the rice cycle – as the total potential audience of rice farmers in Asia is more than 200 million.

Sources: K L Heong; Heong et al, 1998; Escalada et al, 1999

18. Vietnam: National IPM for Rice Programme

Vietnam has seen spectacular progress with its implementation of the FFS approach, with some 250,000 farmers trained since 1992. The programme began by focusing on rice, but quickly spread to vegetables, soybean, cotton, tea and rice-fish culture. It works in all 53 provinces, with nearly 9000 FFS organised by the national programme, with about one third funded by local sources and NGOs. In many villages, IPM graduates form IPM clubs, which meet to discuss IPM, conduct collaborative research, and test new practices (eg fish in rice, IPM on vegetables). The programme has seen rice yields increase by about 3%, pesticide expenditure fall by 80%, pesticide application events fall by 79% (from 1.1 to 0.23 per season), and urea use fall by 10%. Farmers have also changed the timing of fertilizers, spreading them more evenly though the season. Long-term studies show that insecticide applications remain at about 25% of the former level. National policy support has played a vital role, including 1993 legislation on plant protection, a clean vegetable programme for organic production, limits on the import of restricted pesticides, pesticide bans, bans on new pesticide factories, and the establishment of a national cross-ministry IPM Steering Committee.

Source: Eveleens et al, 1996

19. The Rice-Shrimp Farming Systems in the Mekong Delta, Vietnam

This system is dominant in the coastal line area of My Xuyen district, Soc Trang province where brackish and saline water prevails during the dry season. This system was perfected in 1989-1990. Farmers can get more income from this system instead of just having one rice crop. The rice-shrimp farming system consists of the following steps:

i) Field construction

The field is well constructed as described in the rice-fish system. The surrounding dike usually is 2.5 to 3.0 m wide at surface, 3.5 to 4.0 m at base, and 0.8 to 1.0 m high. The trench system is constructed parallel to the surrounding dike. A shallow drainage (ditch) system inside is also constructed to connect with the trench system. The trench is 2.0 to 2.5 m wide at surface, 1.2 to 1.8 m at base, and 0.6 to 0.8 m deep.

ii) Rice component

The rice field is prepared during the start of the rainy season. Saline water is let out of the field and the soil is flushed by the rainwater. Initially the soil salinity might be high. However, after a few rains the salinity is reduced. Flushing period takes one or two months depending on the rain intensity. The seedling nurseries are prepared in early rainy season. Rice fields are cleaned of weeds and algae, without tillage, before transplanting in July and sometimes continues until early August. IR42 is a typical variety used in this system. Seedlings are transplanted at the age of 30 to 40 days. The yield of IR42 is 4.3 t/ha.

iii) Shrimp component

After harvesting the rice crop near the end of the rainy season, while the soil is still wet and the river water has not yet become saline, farmers allow river water to enter the field to raise shrimp (*Penaeus* spp. or *Macrobrachium* spp.) until December. The first shrimp harvest is done after the end of the rainy season. Again, the field is prepared for rearing another crop of shrimp in December and this field preparation may continue until January. Intake of saline water into the field is done at high tide. Water management is important during growing period. Exchange of water is done one or two times a week to create a continuous flow of water in the field. Stocking of *Penaeus* is carried out between January and March. Stocking density is 0.84 juveniles/sq m. Feeding shrimp with cassava, coconut meal, milled rice, and fish meal is common. Harvesting of shrimp is done between April and June. Average yield of shrimp is about 190 kg per ha.

The gross margin (without labour costs) of this system is at US$1,223/ha/year. Total labour requirement of the system is 194 person-days and gross margin per total labour-day is at US$ 6.3. Compared with rice monoculture, the gross margin is only US$514/ha/year.

Source: Vo-Tung Xuan