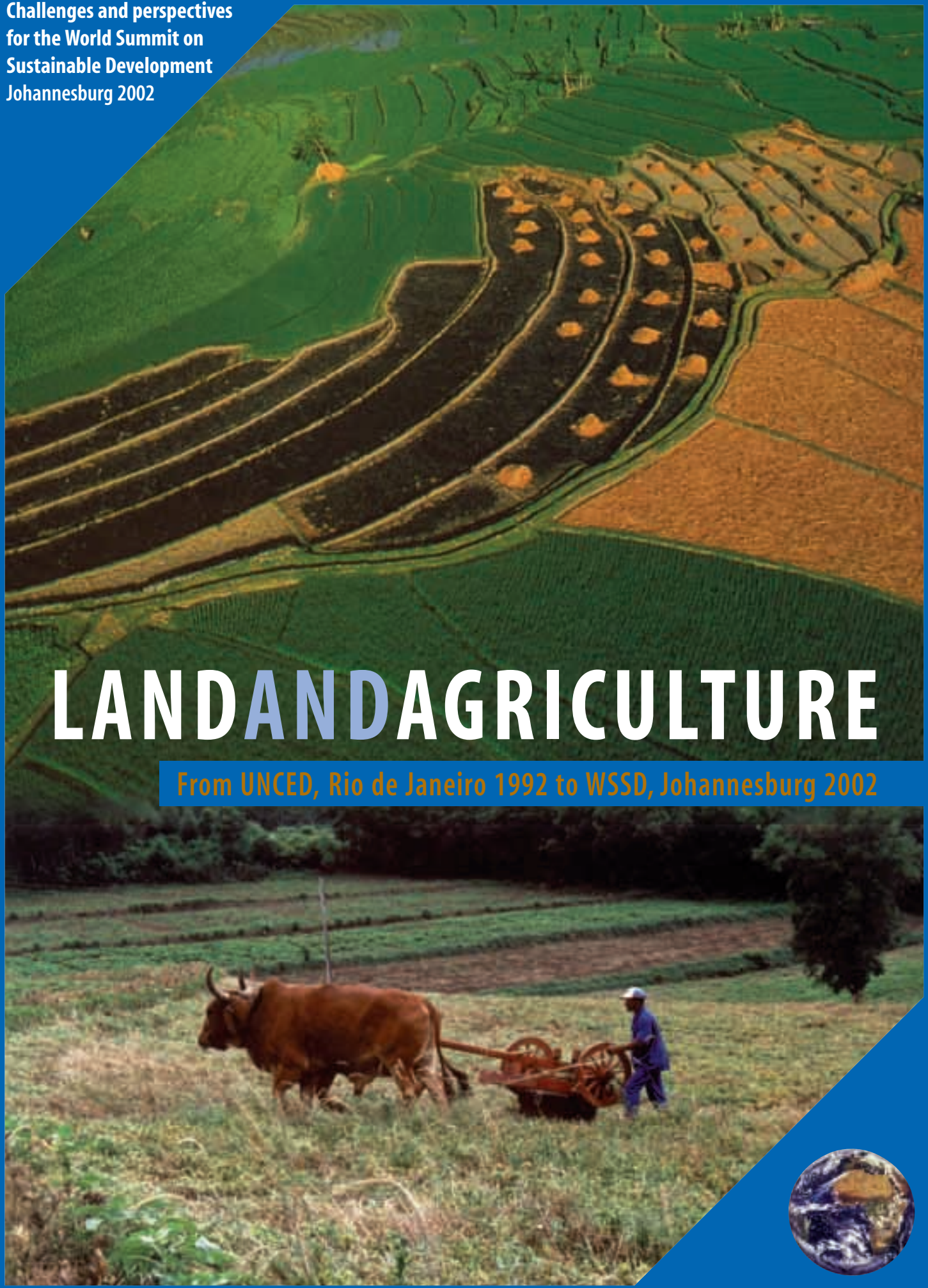
Challenges and perspectives for the World Summit on Sustainable Development Johannesburg 2002



LANDANDAGRICULTURE

From UNCED, Rio de Janeiro 1992 to WSSD, Johannesburg 2002

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for the World Summit on
Sustainable Development
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A compendium of
recent sustainable development initiatives
in the field of agriculture and land management

In recent decades, a wide variety of doomsday stories have repeatedly documented the growing role of agricultural systems in the degradation and depletion of natural resources, the pollution of the environment and the contamination of food products. These alarming trends and the multiplication of droughts, pest and disease outbreaks and food shortages and famines, seemed to cast doubt on the feasibility of providing sufficient, reliable and safe food supplies to an ever-increasing world population. In addressing these problems in Rio de Janeiro, the UN Conference on Environment and Development adopted in 1992 a series of measures for action in three important areas: sustainable agriculture and rural development (SARD), combating desertification and drought, and integrated planning and management of land resources.

Ten years later, the UN Commission on Sustainable Development (CSD) decided to review progress in these three closely related areas as part of one single cluster "land and agriculture". It underlined the importance of the commitment taken by the World Food Summit in Rome to half the number of undernourished by 2015 (nearly 800 million people at present). The CSD pointed to the urgency and the difficulty of this challenge particularly in the face of a shrinking land resource base for agriculture arising from competition for land and water resources and multiple degradation and depletion processes and in the wake of multilateral negotiations on agricultural trade. The member governments of the CSD therefore requested more concrete evidence that progress in these three areas was not only feasible but also actually occurring. To this end, it requested that success stories illustrating positive developments in the land and agriculture cluster be collected and compiled in a compendium which could serve as examples and indicate further directions for action.

There is great diversity in agricultural and rural systems throughout the world. Thus the adoption of common criteria and indicators for a worldwide selection of successful cases represented a significant challenge and could have gone against the basic values attached to this diversity. A further difficulty is represented by the problems of the scale and the time frame for measuring progress towards sustainability. Such progress was assessed jointly on the three fronts of sustainable development: economic, social and environmental. Moreover a balance was sought among the cases presented (for example, many cases of successful agriculture practices were available whereas only few cases of integrated SARD policy were obtained). The selection was, therefore, made on the basis of a consensus of experts and local stakeholders relying on their experience and judgment.

The resulting mosaic of successful cases collected is heterogeneous and so shows that there is no simple panacea, but rather a wide range of possible initiatives and contributions to the attainment of SARD and sustainable land resource management. Most are addressing a specific situation or problem encountered. In order to facilitate their review and assessment, a framework of basic questions and areas of intervention was developed within which the cases were sorted according to their main thrust. The emerging picture shows the many areas where some promising progress is being made. This compendium is not, however, an exhaustive account of all the positive results achieved at various levels in the implementation of the Rio agreements in the agricultural and rural sectors.

The optimism which might come out of the "success stories" presented here should not conceal the existing shortcomings and gaps and the immensity and difficulty of the tasks ahead of us in achieving the objectives of SARD and sustainable management of our land resources. The compendium draws attention to the trade-offs and secondary problems which result in successes in one area or for only some segments of the population. There is no room for complacency. This was confirmed by the review recently made of the progress achieved five years after the World Food Summit, which showed that, at the present pace, the reduction by half of the number of undernourished in the world by 2015 will not be attained, unless a much stronger political will emerges to reduce food insecurity.

The challenge is likely to become even harder as the agricultural and rural sectors are particularly vulnerable to the ongoing global changes such as those created by the globalisation of trade, the introduction of new technologies, and the anthropogenic modification of climatic conditions. Nevertheless the basic premises underlying the strategies of SARD and of integrated management of our land resources remain as valid today as when they were enunciated in the Agenda 21 adopted by governments in Rio ten years ago. The sustainable development of the agricultural sector should go hand-in-hand with broader development and investment efforts in rural areas, with the steady improvement of the rural livelihoods, the achievement of a better food security and food safety for consumers, and a more rational and equitable utilization and conservation of our limited land resources for present and future generations.

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Acronyms / Abbreviations

CARDER	Centre d'Action Regional pour le Developpement Rural
CIAL	Local Agricultural Research Committees
C-MAD	Community Mobilization against Desertification Programme
EPAGRI	Empresa de Pesquisa Agropecuária e Difusâo de Technologia de Santa Catarina
FFS	Farmer Field School
FUL	Förderprogram Unweltschonende Landbewirtschaftung
GAO	Grupo de Agricultura Organica
GoR	Government of Rajasthan
GTZ	Deutsche Gesellschaft für Technische Zusammenarbeit
HEKUL	Hessiches Kulturlandschaftaprogramm
IACR	Institute of Arable Crops Research
ICIPE	International Centre of Insect Physiology and Ecology
ICLARM	The International Centre for Living Aquatic Resources Management
ICRAF	International Centre for Research in Agroforestry
IFAD	International Fund for Agricultural Development
IPGRI	International Plant Genetic Resources Institute
IRRI	International Rice Research Institute
ISMAM	Indígenas de la Sierra Madre de Motozintla
KfW	Kreditanstalt für Wiederaufbau
MEKA	Marketentlastungs und Kulturlandschaftsausgleichcheme of Baden-Würtemburg
NABARD	National Bank for Agriculture and Rural Development
NGO	Non-Governmental Organization
PIM	Participatory Irrigation Management
RTC	Rural Training Centre
SARD	Sustainable Agriculture and Rural Development
SIDA	Swedish International Development Agency
WUA	Water Users Association

Rationale for a compendium of recent sustainable development initiatives in the field of agriculture and land management

While there has been considerable progress in increasing food production and understanding natural resource management since the United Nations Conference on Environment and Development (UNCED, 1992), severe problems of food insecurity, poverty and environmental degradation still persist.

Over the past 40 years, per capita world food production has grown by 25 percent, and food prices in real terms have fallen by 40 percent. As a measure of this growth, average cereal yields grew from 1.2 t/ha to 2.52 t/ha in developing countries between the early 1960s and late 1990s, whilst total cereal production has grown from 420 to 1 176 million tonnes per year. Yet the world still faces a fundamental food security challenge. Despite steadily falling fertility rates and family sizes, the world population is expected to grow to 8.9 billion by 2050. By this time, 84 percent of people will be in those countries currently making up the 'developing' world.

At the year 2000, there were 790 million people hungry. Despite progress on average per capita consumption of food (up 17 percent in the past 30 years to 2 760 kcal), people in 33 countries still consume under 2 200 kcal per day. Although a combination of increased production and more imports will mean per capita consumption will increase to about 3 000 kcal per day by 2015, food insecurity and malnutrition is expected still to persist. Food demand will both grow and shift in the coming decades for three reasons:

- increasing numbers of people (until at least the mid to late twenty-first century) mean the absolute demand for food will increase;
- increasing incomes mean people will have more purchasing power (even though many will remain on no more than US$1/day);
- increasing urbanization means people will be more likely to adopt new diets, particularly consuming more meat – demand is expected to double by 2020 in developing countries, and increase by 25 percent in industrialized countries, helping to drive a total and per capita increase in demand for cereals (it takes 7 kg of feed to produce 1 kg of feedlot beef, 4 kg for 1kg of pork, and 2 kg for 1 kg of poultry).

The 55th Session of the General Assembly in its resolution 55/199 of 20 December 2000 has decided to organize the review of progress in the implementation of Agenda 21 and other outcomes of UNCED at summit level. The Summit is held in the summer of 2002 in Johannesburg, South Africa, and is called the World Summit on Sustainable Development. This compendium of cases of improved land management and sustainable agriculture and rural development (SARD) has been developed as a supporting document for the Task Manager's Report to CSD+10 on the land and agriculture cluster for chapters 10, 12 and 14 of Agenda 21.

This report draws together 75 cases illustrating the many features of UNCED, Agenda 21 implementation. These are drawn from 45 countries. These are intended to provide important supporting evidence to answer five key questions for decision-makers:

- What technical innovations are leading to improvements in food production with SARD?
- What novel institutional partnerships and joint working arrangements have been developed for the implementation of Agenda 21 in the agriculture sector?
- What examples of enabling policies have been implemented by governments to support sustainable land management and SARD?
- What rural development outcomes have occurred with successful implementation of SARD?
- What wider environmental outcomes have been achieved with successful implementation of Agenda 21?

These 5 key areas are divided into a total of 20 secondary subsections.

Key conceptual issues

Recent years have seen significant convergence in both concepts and implementation themes for SARD. These illustrate a growing understanding of the nature of sustainable agriculture, its links to rural development, and the increased involvement of a wide range of institutions in implementation. These include public and private, government and non-government, and local, national and international.

What then do we understand by sustainable agriculture? In the first instance, a more sustainable food production system seeks to make the best use of nature's goods and services whilst not damaging the environment (for a list of key references, see bibliography at the end of report). SARD does this by integrating natural processes such as nutrient cycling, nitrogen fixation, soil regeneration and natural enemies of pests into food production processes.

It also minimizes the use of non-renewable inputs (pesticides and fertilizers) that damage the environment or harm the health of farmers and consumers. It makes better use of the knowledge and skills of farmers, so improving their self-reliance. And it seeks to make productive use of people's capacities to work together to solve common management problems, such as pest, watershed, irrigation, forest and credit management (now commonly termed as social capital).

SARD jointly produces food and other goods for farm families and markets, and also contributes to a range of public goods, such as clean water, wildlife, carbon sequestration in soils, flood protection, landscape quality. It delivers many unique non-food functions that cannot be produced by other sectors (e.g. on-farm biodiversity, groundwater recharge, urban to rural migration, social cohesion). SARD is therefore multipurpose, having many positive externalities (or side effects), whilst reducing negative externalities to a minimum.

Sustainable agriculture comprises agricultural technologies and practices that maximize the productivity of the land whilst seeking to minimize damage both to valued natural assets (soils, water, air, and biodiversity) and to human health (farmers and other rural people, and consumers). It focuses upon regenerative and resource-conserving technologies, and aims to minimize the use of harmful non-renewable and fossil fuel derived inputs.

As it seeks to make the best use of nature's goods and services, so the technologies and practices must be locally adapted. These emerge from new configurations of social capital (relations of trust embodied in new social organizations, and new horizontal and vertical partnerships between institutions) and human capital (leadership, ingenuity, management skills and knowledge, capacity to experiment and innovate).

Sources of evidence

This compendium draws on a wide range of sources of information on SARD derived from developing, industrialized and transition country contexts. Three key elements form the cornerstone of this knowledge:

- The FAO dataset developed for the Maastricht conference on Cultivating Our Future, held in September 1999, which contains details of 160 projects (www.fao.org).
- The University of Essex dataset developed for the "Reducing Food Poverty with Sustainable Agriculture" research project (1998–2001), which contains narrative details of 47 projects and initiatives in developing countries, plus supporting analytical and descriptive documentation of the whole database of 208 cases (www.essex.ac.uk/ces).
- The FAO Secretariat of the Committee on World Food Security (CFS) and FAO Special Programme for Food Security (SPFS) case studies.

In addition, FAO has organized an e-conference during March 2001 to gather further information and insights on land and SARD initiatives.

Framework for cases of SARD

The cases of successful sustainable agriculture were sorted according to a framework comprising of five key questions for decision-makers. These address technical innovations, novel institutional partnerships, enabling policies, rural development outcomes, and environmental outcomes. These are then sorted into 20 secondary areas of interest (see Figure) relating to technical innovations, institutional arrangements, enabling policies, and rural development and environmental outcomes.

Each SARD case is sorted into the most appropriate section according to its primary and secondary pointers to illustrate the main lessons learned from the case. Each comprises a short narrative describing the key elements of both process and outcomes achieved.

Five primary questions for a compendium of recent sustainable development initiatives in the field of agriculture and land management

1. What technical innovations are leading to improvements in food production with SARD?
2. What novel institutional partnerships and joint working arrangements have been developed to implement Agenda 21 in the agriculture sector?
3. What examples of enabling policies have been implemented by governments to support sustainable land management and SARD?
4. What rural development outcomes have occurred with successful implementation of SARD?
5. What wider environmental outcomes have been achieved with successful implementation of Agenda 21?

1. Technical innovations leading to improvements in food production	2. Novel institutional partnerships and joint working arrangements	3. Enabling policies implemented by governments	4. Rural development outcomes	5. Environmental outcomes
Soil quality improvements	Novel partnerships	National integrated policies	Women's and children's status improvements	Regional biodiversity improvements
Better efficiency of green and blue water use	Social groups and federations	Subnational integrated policies	Rural jobs and migration patterns	Water quality and quantity improvements
Pest management with minimum-zero pesticides	Private sector and sustainable agriculture	Integrated pest management	Dietary and reproductive health	Calculations of externalities (side effects) of agriculture
Whole system redesign and large-scale adoption		Soils and land management		New carbon sinks in agriculture
		Economic instruments		
		Support for farmers' groups		

Confounding factors and trade-offs in SARD implementation

The evidence shows that Sustainable Agriculture and Rural Development (SARD) as defined in Agenda 21 can lead to rural livelihood improvements. People can be better off, have more food, be better organized, have access to external services and power structures, and have more choices in their lives.

However, most contexts will see the emergence of critical trade-offs and contradictions. The use of one asset can result in the depletion of another – building a road near a forest can mean loss of natural capital, as it aids timber extraction; investing in motorized fishing boats means increased capacity to harvest fish (unless, in both cases, there is strong social capital in the form of institutions to mediate access and ensure sustainable levels of offtake).

This is not to say that depletion of one asset is always undesirable – it may be in the national and local interests to convert part of a forest into finance, if that money is to be used for investment in hospitals and schools, effectively producing a transfer from natural to social and human capital. Equally, short-term social conflict may be a necessary means to overcoming inequitable land ownership, so as to produce higher welfare outcomes.

In some cases, progress in one component of a farm system may cause secondary problems. For example, projects may be making considerable progress on reducing soil erosion and increasing water conservation through adoption of zero-tillage, but still continue to rely on applications of herbicides. In other cases, improved organic matter levels in soils may lead to increased leaching of nitrate to groundwater.

There are a variety of secondary problems that may arise in SARD projects. These include:

- land having to be closed off to grazing for rehabilitation, resulting in people with no other source of feed having to sell their livestock;
- increased household workload, the burden particularly falling on women, if cropping intensity increases or new lands taken into cultivation;
- additional incomes arising from sales of produce may go directly to men in households, who are less likely than women to invest in children and the household as a whole.

There are also a variety of confounding factors that could make SARD 'successes' less favourable:

- Sustainable livelihoods based on SARD may be marketing foodstuffs into an increasingly globalizes world food system, in which the transport externalities (the negative impacts on atmospheric composition through carbon dioxide emissions) outweigh any localized asset-building;
- Sustainable livelihoods based on SARD which increases the assets base may simply increase the incentives for more powerful interests to take over, such as landlords taking back formerly degraded land from tenants who had adopted sustainable agriculture;
- Sustainable livelihoods based on SARD may appear to be keeping people in rural areas away from centres of power, and 'modern' society – some rural people's aspirations may precisely to be to gain sufficient resources to leave rural areas;
- Sustainable livelihoods based on social capital formation and the emergence of significant social movements may represent a threat to existing power bases, who in turn are likely to seek to colonize locally based institutions;
- Barriers to entry may increase as existing adopters of SARD may seek to prevent others from benefiting.

There will also be new winners and losers with the emergence of sustainable agriculture on a significant scale. This model for farming systems implies a limited role for agro-chemical companies, who would not be predicted to accept such losses of market lightly.

It also suggests greater decentralization of power to local communities and groups, combined with more local decision-making. This means reduced opportunities for rent-seeking and other forms of corruption from officials in private and public organizations. Research and extension agencies will have to change too, adopting more participatory approaches to work closely with farmers, and so must adopt different measures for evaluating job success and the means to promotion.

But even if the intention is present for the development of SARD, there are still many threats to overcome or avoid if it is to succeed and spread. These include lack of land tenure or security, civil disorder and wars, institutional inertia, the backlash from potential losers, macro-economic decline of countries or regions, and continued climatic change and disruption.

The globalization of world agriculture will provoke further changes. More control of the world food systems will be centralized in fewer and larger private companies. This centralization could be good, with companies influencing whole supply chains, but is only likely to happen if companies have good ethical and sustainable bases for operations. The effects on small farmers are more likely to be severe than beneficial.

In some cases, the global nature of markets can undermine sustainable agriculture systems, with farmers rapidly shifting away from sustainable practices to exploit a short-term opportunity. Farmers may take advantage of such cash crop opportunities at the expense of food security. Domestic markets can be rapidly lost to cheap imports from countries externalizing some of the real costs of production – such as European countries exporting milk products to India.

Compendium of recent sustainable development initiatives in the field of agriculture and land management

The main part of this report contains short narratives on 75 sustainable land management and SARD projects and initiatives. These have been chosen for illustrative purposes only, and so should not be seen as a comprehensive listing of all SARD related activities worldwide. There are many hundreds of successful initiatives that do not appear herein, and their omission should not be taken as implying that they are any less effective or successful that those in this compendium.

Each case in this compendium has been selected and classified because it makes a clear contribution to one or more of the five primary questions and twenty secondary areas of interest. Many cases, of course, are multifaceted in their effects, and could have appeared in several sections. For the ease of reading, they only appear once.

Land and soil quality improvements

SUMMARY

Nineteen cases have been selected to illustrate the types of technical innovations leading to food production increases with SARD.

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 Appliquée en Milieu Réel* 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.

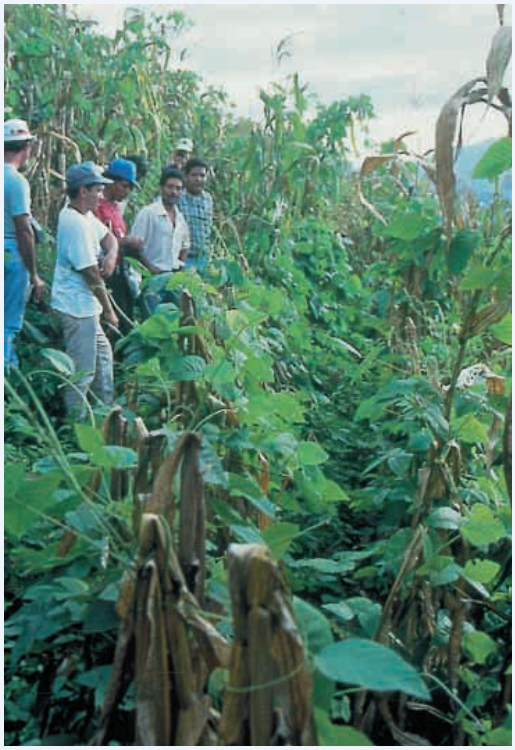
Farmers who adopted *mucuna* cover cropping benefited from higher yields of maize with less labour input for weeding: maize following *mucuna* yields 3-4 t/ha without application of nitrogen fertilizer (similar to yields normally obtained with recommended levels of fertilization at 130 kg N/ha); whilst 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:* Robert Carsky, IITA, Benin < r.carsky@cgiar.org >

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 2 000–2 500 kg/ha. Farmers use green manures, cover crops, contour grass strips, in-row tillage, rock bunds and animal manures, which are finely tud 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, e.g. *campesino a campesino* movement in Nicaragua and elsewhere, the spread of this simple technology has occurred rapidly. ■



→ *Source:* Roland Bunch, COSECHA, Honduras < rolando@cosecha.sdnhon.org.hn >
Juan Carlos Moreira, Centro Maya, Guatemala < centromaya@guate.net >

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 smallholders. Farmers typically plant whole 0.5–1 ha 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 650–1 750 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 – e.g. 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 3 300–5 500 kg/ha, and bean yields four to eight 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, soybean, groundnut, pigeon pea and Irish potatoes, as well training farmers in organic vegetable production in raised beds in home gardens. ■

→ *Source*: Beth Kirungu, Joseph Mureithi

Philippines: Contour farming on sloping lands in Claveria

Claveria is in northern Mindanao, and is characterized 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 2 000 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 6 000 ha), maize yields have improved 15–25 percent and land values by 35–50 percent. ■

→ *Source:* Dennis Garrity, ICRAF

Senegal: Rodale Regenerative Agriculture Research Center

In Sahelian countries, the major constraints to food production are related to lack of moisture and 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 (RARC) 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 groundnat 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 2 000 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 percent improvement in millet yields – from 330 to

600–1 000 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*". ■

→ *Source:* Amadou Diop, Rodale Institute < adiop@rodaleinst.org >

Better efficiency of green and blue water use

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 water 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 ha have been restored – producing some 700 kg/ha of grain 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 700–1 000 kg/ha in a good rain year. Reij (1996) indicates that the average family in Burkina Faso using these technologies has 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:* Reij (1996)

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

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 by-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 percent (from 3 to 4.2 t/ha), and spring maize by 38 percent (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

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, SPEECH, Madurai, Tamil Nadu < speech@md3.vsnl.net.in >

Malawi: Small-scale aquaculture

The International Centre 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 2 000 individual farmers on both vegetable improvements in home gardens and fishpond 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 2 700 to 4 000 kg/ha, and fish ponds produce the equivalent of 1 500 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 percent 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 1 500 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 unraveled 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)

Peru: Raised fields in Lake Titicaca Basin

The Proyecto Agrícola de los Campos Elevados works with Quechua communities in and around the District of Huatta to rehabilitate ancient raised fields. These chinampas or *waru-waru* were used widely in the Lake Titicaca basin by pre-Hispanic farmers, but had fallen into disuse. In addition, many thousands of hectares had been destroyed by modern, capital-intensive irrigation projects that then failed to improve agricultural yields. The Basin, located about 3 800 m above sea level, is a difficult environment for agriculture because of irregular rainfall, poor and degraded soils, and frequent and severe frosts during the short growing season. Pre-Hispanic farmers had developed sophisticated ways to overcome these limitations, by focusing on diverse and intensive cropping on terraces, sunken gardens (*gochas*) and raised fields (*camellones or waru-waru*), together with social mechanisms to ensure efficient and collective action to achieve high and secure levels of productivity. Local farmers' organizations of Huatta, involving some 500 families in ten communities, began to reconstruct these ancient raised fields. The success of the effort was because of the community participation and the development of effective teaching and learning materials. Although the technology was new to present-day farmers, it was they who conducted the experiments to adapt the technology to their own conditions. In 1986, the programme was taken on by the Peruvian government, and has since expanded to include over 30 altoplano communities.

Raised beds require strong social cohesion for the cooperative work needed on beds and canals. For the construction of the fields, labour was organized at the individual family, multi-family and communal levels. Most of the raised fields were constructed on community-owned land that had formerly lain unused for want of local motivation and presence of appropriate institutions. The labour required for construction was between 200–900 person-days per ha, depending on local physical conditions. The raised fields are surrounded by canals, which trap silt, improve the micro-climate for crops, act as a barrier to pests and grazing animals, and act as a habitat for aquatic animals. This microclimate of beds and canals reduces frost incidence. Soil fertility is maintained by green manuring with aquatic plants, livestock manures and crop-weed residues. This fertility encourages a highly productive agriculture. Potato yields are 8–14 t/ha without use of pesticides or fertilizers. This compares with an average of 1–4 t/ha using fertilizers for the Department of Puno. Extra crops are grown, with forage crops of oats, wheat and barley now grown in winter. These raised fields are also more resilient: one year hundreds of hectares of mechanically prepared fields of wheat and potatoes were destroyed by flooding, but raised fields adjacent to them were unaffected. ■

→ *Source:* Altieri (1999); Pretty (1995)

Pest management with minimum/zero pesticides

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 6 000 farmer field schools have been completed, with about 150 000 farmers adopting more sustainable rice production on 54 000 ha. The programmes also emphasize fish cultivation in paddy, and vegetable cultivation on rice field dykes. Rice yields have improved by 5–7 percent, and costs of production have fallen owing to reduced pesticide use – some 80 percent 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 US$156/ha, from vegetables on dykes US$23/ha, but fish and vegetables together bring an additional US$250/ha. As a result, the 150 000 participating households are now food secure throughout the year. ■

→ *Source:* Desilles (1999)

Kenya: *Vutu-sukumu* (push-pull) pest management in smallholder systems

The work of International Centre of Insect Physiology and Ecology (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. 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* sp.).
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 defense 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 percent to 18.9 percent when the grass was planted around maize in a field and from 0.5 percent to 6.2 percent 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 Striga 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. ■

→ *Source:* Dr Hans Herren, Director-General of ICIPE < hherren@icipe.org >
Prof John Pickett, IACR, Rothamsted < john.pickett@bbsrc.ac.uk >

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 1 719 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 percent decrease in pesticide use in the wet season (55 percent fall in the dry season) and the synthetic fertilizer rate has halved, giving farmers a net rise in income of 17 percent. Vegetable yields have also increased by about 20 percent. Farmer field schools are now considered locally to be a good investment by municipal authorities. ■

→ *Source:* FAO, Peter Kenmore

Zimbabwe: Organic farming of cotton with natural pest management

This project involves 400 households, and has led to the elimination of organophosphate and pyrethroid pesticides from the farming system, provided information and training in sustainable agriculture directly to farmers, and led to the conservation of indigenous trees.

This project was initiated by a group of resource-poor, mainly women farmers who were keen to produce cotton without pesticides for economic, health and environmental reasons. A local NGO, ZIP Research, was asked to provide training and research assistance for the farmers, due to their lack of knowledge, regarding pest management and organic agriculture. This training is provided during regular farmer field schools, which are facilitated by farmers who have been selected by their group and trained for one month by ZIP Research at the Eco-Lab, near Harare. These facilitators (or 'Farmer Field Workers') are trained, during a process of 'learning through experimentation' (based on the FAO IPM model) in natural pest management and organic farming. The Farmer Field Workers collaborate in farmer-participatory research and are also responsible for operating the 'organic internal control system'. These activities are regularly followed up by ZIP Research. Funds for the training and follow-up are being provided by Novib. In order to encourage more women into the organic project, a local market has been found for their groundnuts. In addition, the organic inspectors (from Krav and Ecocert) have accepted the conditional 'wives special exception', in which a wife may be allowed to have her unsprayed cotton certified, even though her husband is still a conventional farmer. Furthermore, considering that cotton, in common with most cash crops, is considered to be a 'mans crop', while many AIDS widows are keen to grow cotton in order to generate a cash income, organic production is accessible to these resource-poor farmers because there is no need for costly inputs. Marketing of the organic products from this project is a crucial aspect of this project and this service is being provided by the local consultant from Agro Eco. The organic seed-cotton is sold to Cargill at a premium which is currently 20 percent. Last years harvest of one tonne of organic lint is being locally processed into export quality, printed T-shirts. Once the farmers are able to produce more than 25 tonnes of organic lint (or one container load) it can be sold on the world market at an enhanced premium. This season's harvest is expected to be between 50 and 70 tonnes of organic seed cotton, depending on the rains, which are currently casing flooding in the area. Five percent of the premium is used to remunerate those Farmer Field Workers who are judged by their farmers and ZIP Research staff to have performed well during the season.

This is a 'development through trade' project and initial running costs came from Sida/EPOPA. This project/enterprise is continuing due to the enthusiasm of the farmers and the support of Novib, the United Kingdom Pesticide Action Network, Cargill and the dedicated work of the Agro Eco consultant and ZIP Research staff. The most outstanding results are that the farmers in the Zambezi Valley were able to market Zimbabwe's first organic cotton. Zip Research has developed an organic conversion process for commodity crops that can be used to assist in the conversion of all smallholders in Africa. ■

→ *Source:* Pesticides Action Network UK at < www.pan-uk.org >

WHOLE SYSTEM REDESIGN AND LARGE-SCALE ADOPTION

China: Wheat-Maize Double Cropping System Programme, Hebei Plain

The Wheat-Maize Double Cropping System Programme 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 100 000 ha. Yields have improved by about 10 percent, water use has been reduced by 30 percent, and fertilizer use reduced by 20 percent. As a result, net returns have improved by 30 percent. ■

→ *Source:* Liang Weili

India: The spread of soybean cultivation

The rapid spread of soybean in Indian farming systems illustrates how the introduction of a single regenerative component into farm systems can have multifunctional benefits. The change in extent has been from some 0.04 million ha in the mid-1960s, rising to 0.5 m ha in the 1980s (ave. yield 0.57 t/ha), and now 5.6 million ha (ave. yield 0.96 t/ha). Each year, some 0.5 m ha are added to cultivation, with extent expected to pass 8 m ha by the year 2000. Soybean exports in 1997 earned India US$518 million (Rs 20 bn).

The multifunctional outcomes of soybean cultivation in India are:

- Oil production – soybean has played an important role in national self-reliance in edible oils
- Foreign exchange
- On-farm nitrogen fixation and contribution to natural capital
- Rural employment through soya based agro-industry
- Compatibility as intercrop with other monsoon (kharif) crops such as pigeon pea, maize, sorghum, finger and pearl millet
- Monetary returns for farmers
- Contribution to soil fertility through organic matter addition – 0.5–2.5 t/ha of crop residues and 45 kg N/ha of fixed nitrogen (equivalent to the free use of 250 000 tonnes of nitrogen fertilizers per year, and the addition of 2.8–14 million tonnes of organic matter)
- Rehabilitation of degraded lands – e.g. in Punjab where continuous rice-wheat systems would benefit from introduction of soybean into rotation
- 95 percent of seed saved from previous harvest, so farmers not dependent on external seed delivery systems. ■

→ *Source:* Bhatnagar and Joshi, FAO

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 percent 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 minimizing the need for purchased inputs. The technical elements include intercropping, localized 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 2 000 farmers are now practising this system. ■

→ *Source:* Pantanali (1996)

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:

1. 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.
2. Rice seedlings are usually planted close together to minimize 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 70 kg/ha. Wider spaced plants develop a different architecture, with more room for roots and tillers. Better root systems means reduced lodging.
3. 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 periods 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.

4. 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. SRI farmers also 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 pnciples 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). ■

→ *Source:* Sébastien Rafaralahy, ASSOCIATION TEFY SAINA < tefysaina@simicro.mg >
Prof. Norman Uphoff, CIIFAD, Cornell University, USA < ntu1@cornell.edu >

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 percent of the 580 participating households, organized 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:* Jajarkot Permaculture Programme (1997-2000); Chris Evans, pers. comm.

India: Participatory Integrated Watershed Development

The Integrated Watershed Development in Kharaiyanala in central India is a part of the overall strategy of the Government of India to increase food production and food self-sufficiency at national level as well as to address the needs of the poor at the community and at the household level. The Plan of Action for Food Security in India incorporates policies and programmes aimed at increasing food production, including through Integrated Cereal Development Programmes focussing on the propagation of improved production technology, encouragement of the production of certified High Yielding Varieties (HYV) of seeds, and expansion of irrigation. Another priority action

area is improved watershed management. The strategy also embraces policies relating to procurement and storage, public distribution systems and maintenance of buffer stocks and open market sales. The participatory watershed development approach in Kharaiyanala, within the overall Food Strategy of India, reflects a success story in overcoming food insecurity and poverty at community level. ■

→ *Source:* FAO, CFS

Brazil: Conservation 'No Tillage' Agriculture:

The Conservation "No Tillage" Agriculture in Santa Catarina, Brazil, demonstrates a non-conventional approach which focuses on the maintenance of both live and decaying vegetable material on the soil surface. Besides maintaining continuous soil cover and eliminating soil tillage, conservation agriculture involved planning crop sequences over seasons, to minimise the building-up of pests or disease and to optimise plant nutrient use. The approach in a few years led to higher yields in crop production, decline in labour costs, diversification into livestock as well as agro-processing, resulting in improved food security of small farmers. ■

→ *Source:* FAO, CFS

Burkina Faso: Small Scale Irrigation Development under the Special Programme for Food Security

The Special Programme for Food Security (SPFS) in Burkina Faso is an integrated approach focussing on promoting appropriate technologies and farming practices, using improved water use and management systems as an entry point. The SPFS in Burkina Faso has shown significant increases in yields both in irrigated and rainfed rice as well as vegetables in the demonstration areas. The Programme forms part of the national programme for sustainable growth in agriculture and livestock. The SPFS will be instrumental in improving food security and eradicating poverty, provided appropriate macro-economic and sector policies, credit and input supply, as well as marketing facilities are in place to ensure widespread application of improved technologies and increase in productivity. ■

→ *Source:* FAO, CFS

Bangladesh: Co-operative Dairy Development Programme

The Co-operative Dairy Development Programme in Bangladesh had been implemented in line with the Government's long-term objective of raising subsidiary agricultural income of small and poor farmers in relatively remote rural areas. Using milk production, collection, processing and distribution as an entry point, the project provided a comprehensive range of technical support ranging from institutional development for establishing co-operatives and credit schemes at community level to organizing appropriate milk distribution and marketing systems in urban centres. The project not only was successful in improving the food security, nutrition and income of the direct beneficiaries – 40 000 landless and marginal milk producers – but also generated employment and income opportunities for a large number of the urban poor. ■

→ *Source:* FAO, CFS

Zambia: Community-Based Seed Multiplication and Distribution

The community-based seeds multiplication and distribution systems in Zambia used the supply of early maturing and drought resistant seeds as an entry point to address low productivity and vulnerability to droughts as well as to tackle food insecurity and poverty. The project demonstrated that, once small farmers attain food self-sufficiency through the introduction of improved technologies such as better seeds, and become surplus producers, the need for marketing facilities, credit and other related institutional and physical infrastructures becomes imperative. ■

→ *Source:* FAO, CFS

The above case studies, implemented through Special Programme for Food Security(SPFS) of FAO, albeit their differences in scope and approaches, provide a number of useful lessons for using community-based methods to promote the adoption of new technologies.

- Improvement of food security through application of agricultural technologies at community level can lead to people's enhanced local capacity to engage in development activities in other areas as well.
- Direct involvement of beneficiaries in adapting improved technologies suitable to their conditions has a high payoff in terms of the enthusiasm and interest that they bring to project implementation. Also, in ensuring that the technologies address the priority needs that have been identified by the beneficiaries, have a strong chance of having the desired impact.
- Community-based action can be highly cost-effective.
- When productivity improvements generate additional income for the community members, this reinforces their efforts and encourages them to persevere. Village committees can be an effective mechanism for managing community activities of common interest and for establishing revolving funds to generate credit for community members.
- Community-based actions to increase agricultural productivity through adoption of appropriate technologies and practices also ensure sustainable natural resource management objectives.
- Vulnerability to natural disasters can be substantially reduced through adoption of technologies and practices that a) prevent or mitigate the effects of natural disasters, and b) improve productivity, increase cash incomes and create assets that families can fall back on when disasters occur.
- Without a favorable policy environment allowing surpluses generated by productivity improvements to find market outlets, actions to improve food security and reduce poverty through application of new technologies and practices cannot succeed.

Novel partnerships

SUMMARY

Ten cases have been selected to illustrate the novel institutional partnerships and joint working arrangements developed to implement SARD.

France: National park partnerships

There are a number of important initiatives in the Parcs Naturels Régionaux that are seeking to reconcile local economic development with nature conservation. The common aspects of success in this field are that action occurs at a platform level, so allowing an integrated approach; that there is good negotiation and communication between the various local actors; and the contracts for farmers are voluntary. As the schemes are not imposed, but rather developed through an open and participatory process, farmers do not feel coerced.

Haute Chaumes and Haute Vallées Vosgiennes

The high pastures of the Vosges mountains, long sustained by farming, are under two particular pressures. Land use has intensified in some areas, leading to declining biodiversity, and at the same time land is being abandoned in other areas, leading to tree encroachment and again loss of conservation value. Technical committees were established by the park authorities to draw up a common land management policy with all the main stakeholders. Surveys were carried out with farmers. It was particularly important get everyone involved as the area falls between two regions and is under the control of many local authorities. Farmers have now entered into contracts to follow more sustainable farming practices, such as controlling livestock numbers, not using fertilizers, and not burning.

Marais du Cotentin et du Bessin

The marshes on the Cherbourg peninsula are of international ecological importance, but deterioration of the habitat is now widespread. Neglected wet grasslands turn to peat bogs, become waterlogged, the soils become acid, plant biodiversity falls, and the area becomes less attractive to agriculture. This encourages greater intensification on the remaining grasslands, the productivity of which is increasingly maintained with high fertilizer inputs. A working group was established with local and central government, farmers, conservationists, hunters and anglers. This conducted surveys and experiments with alternative practices. As a result, farmers now enter into contracts to use extensive farming practices that preserve the unique landscape. ■

→ *Source:* Pretty (1998)

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 percent; 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 percent), 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 organized 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)

Kenya: Ministry of Agriculture catchment approach to 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. By the late 1980s, it was clear that the conventional approach to soil and water conservation was unable to meet the prevailing environmental challenge.

The Government of Kenya recognized that the only way to achieve widespread conservation coverage was to mobilize 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 coordinating local activities. A Catchment Report serves as a baseline document for planning, implementation, monitoring and evaluation, and for coordinated 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. ■

→ *Source:* M. Mbote and J.K. Kiara, Soil and Water Conservation Branch, Ministry of Agriculture, Nairobi

United Kingdom:
The North York Moors National Park Farm Scheme, North Yorkshire

The NYM National Park receives some 10–12 million visitor-days each year. In recent years, there have been major environmental changes, with the amalgamation of farms and a sharp decline in employment opportunities. The National Park Committee had been working on a small scale with farmers during the 1980s on projects such as tree planting, drystone wall repair, bracken control and woodland management, but realized it needed to take a more coordinated approach. The NYM Farm Scheme was launched in 1990, with support from the National Park budget.

The NYM Farm Scheme seeks to encourage sensitive land management whilst maintaining farm viability. At present it works with farmers within selected dales. Management agreements are developed with each farmer. These aim to guarantee the conservation of landscape, wildlife and historic features in the National Park, whilst creating new environmental benefits; maintain the rural fabric of the dales; restore and conserve vernacular farm buildings; stimulate the rural economy and creating jobs; and ensure that farmers still have flexibility in their land management decisions.

The scheme is offered to all farmers in a designated area, and by 1996 there was a 90 percent uptake amongst eligible farmers. The personal contacts between staff of the scheme and local farmers is seen as crucial to long-term success, and peer pressure amongst local people helps to keep support high. The management agreements are for five years, are individually tailored, and make provisions for maintenance and management payments. The Farm Scheme has resulted in a marked improvement in the landscape (particularly farm buildings and walls), as well as improving farm incomes and raising farmers' awareness and knowledge of conservation. A recent survey of visitors who regularly walk the landscape showed that they had recognized the changes and valued them. Altogether, sixteen new jobs have been created for the 110 farm agreements – equivalent to one for every seven farms. ■

→ *Source:* Pretty (1998). The Living Land

Social groups and federations

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 decentralized 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 4 000 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 generalized 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 1 400 kg/ha following adoption of agro-ecological approaches.

In communities with CIALs, some 30 percent of households suffer food shortages during August-September, whereas 50–65 percent 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, CIAT, Braun (2000)

Japan: Consumer cooperatives link to farmers

Food cooperatives are an important way to get good food to urban groups with no direct access to farms and the countryside. Direct links between consumers and farmers have had spectacular success in Japan, with the rapid growth of the consumer cooperatives, *sanchoku* groups (direct from the place of production) and *teikei* schemes (tie-up or mutual compromise between consumers and producers). This extraordinary movement has been driven by consumers rather than farmers, and mainly by women. There are now some 800–1 000 groups in Japan, with a total membership of 11 million people and an annual turnover of more than US$15 billion. These consumer-producer groups are based on relations of trust, and put a high value on face-to-face contact. Some of these have had a remarkable effect on farming, as well as on other environmental matters.

The largest and best-known consumer group is the *Seikatsu Club*, a consumer cooperation union and recipient of the Right Livelihood Award in 1989. This has a membership of more than 210 000 households organized into 26 000 *hans*, or local branches, all over Japan. It was set up in 1965 by housewives in Tokyo, who wanted to find a way of avoiding the high price of milk. Their idea was to band together and buy milk directly from farmers. Over the next few years, they also began to purchase a range of food free of pesticides, clothes and cosmetics wholesale. Club members then began to take care of distribution themselves.

In the late 1970s, a new headquarters was set up in Setagaya and the first *Seikatsu* Club housewife was elected to local government the following year. Although 37 members have now entered local politics, the Club seeks a much deeper change, aiming to seek to empower each and every member with a voice and role in participatory politics. Historically isolated in the home, this has given strength and new opportunities to women. The turnover of the *Seikatsu* Club alone is now 40 billion yen (US$320–350 million) and it employs 905 full-time staff. ■

→ *Source:* Pretty (1998). The Living Land; and < http://iisd1.iisd.ca/50comm/commdb/desc/d08.htm >

Kenya: Community mobilization 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 1 000 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

Senegal: Federation of Senegalese NGOs (FONGS)

The FONGS was established in 1978 by government to give greater voice to village-based associations concerned with input procurement, collective food production, processing and marketing. At the beginning of this decade, the FONGS included 24 regionally-based associations made up in turn of 2 000 village groups with a membership of 400 000. Some 1.5 million people in all are thought to be positively affected by grassroots association activities (about 20 percent of the national population).

During the 1990s, farmers increasingly articulated concerns over the modern agricultural model that resulted in over-exploitation of natural resources combined with dependence on increasingly costly non-renewable inputs to boost productivity. At the same time, experiments with sustainable agriculture alternatives were on the increase. A national FONGS organized forum led to the emergence of a new platform bringing together all national federations – the National Council for Rural Dialogue and Cooperation (CNCR), with a membership of three million. In the past five years, CNCR has participated in policy development, established a technical support unit for farmers, and developed a new credit system based on farmers' savings.

Private sector and sustainable agriculture

Worldwide: Unilever plc and Sustainable Agriculture Initiative

More than two-thirds of the raw materials used by the food company Unilever come from agricultural crops and livestock, fisheries and other potentially renewable sources. They are among the world´s largest users of certain agricultural raw materials such as tea, vegetables and vegetable oils. Since the mid-1990s, Unilever has been consulting with experts and engaging with suppliers, customers, consumers and business partners around the world to find a sustainable way forward for agriculture. This has led to the following definition of sustainable agriculture: "*In our definition, sustainable agriculture is productive, competitive and efficient whilst at the same time protecting and improving the natural environment and conditions of the local communities.*"

Unilever explicitly supports the following sustainable agriculture principles:

- Producing crops with high yield and nutritional quality to meet existing and future needs, while keeping resource inputs as low as possible.
- Ensuring that any adverse effects on soil fertility, water and air quality and biodiversity from agricultural activities are minimized and positive contributions are made where possible.
- Optimizing the use of renewable resources while minimizing the use of non-renewable resources.
- Sustainable agriculture should enable local communities to protect and improve their well being and environments.

Unilever has initiated a series of projects around the world to measure the sustainability of its practices according to a set of 10 indicators. The aim is to understand and agree the ecological, social and economic conditions for sustainable agriculture. These will eventually contribute to the development of standards for sustainable agriculture. Their focus is on the underlying health and vitality of agricultural systems—in social, economic and environmental terms: "*We believe that there needs to be a greater diversity of approaches to farm and plantation management. All agricultural systems have something to offer and we want to find out what works best under differing circumstances*". Pilot projects are in tea, tomatoes, palm oil, peas and spinach. The ten indicators being used are: i) Soil fertility/health; ii) Soil loss; iii) Nutrients; iv) Pest Management; v) Biodiversity; vi) Product value; vii) Energy; viii) Water; ix) Social/human capital; x) Local economy. ■

→ *Source:* Jan Kees Vis < Jan-Kees.Vis@unilever.com > < www.unilever.com >

South Africa: Bayer (Pty) Ltd and integrated production in deciduous fruit and vines

The case concerns the production of deciduous fruit and table and wine Grapes. The contribution was through participation by all parties whereby a system was created in which future use of new land is controlled and planning of new plantings and spray programmes and management systems geared to have a minimum detrimental effect on the environment. It involves approximately 165 ha of fruit and vines.

In the early 1990s, producers of fruit, grapes and wine in the Western Cape, became more aware of the need for environmental protection and human safety. An IP steering committee was formed and out of this an Ag Chem environmental group, made up from all role players in the industry from e.g. universities, exporters, coops, research institutes, beekeepers, the agricultural chemical industry etc. Written guidelines for pome and stone fruit, grapes and wine production were drawn up and a scoring system for spray programmes was developed to quantify this aspect. The Ag Chem group meets a few times annually and reviews the guidelines and related practises and codes new crop protection agents by consensus. An informal IPM group, including all role players, meets every 14 days for one hour during the growing season. Trends and topical subjects are discussed and if necessary action taken. Orchard monitoring courses are held for selected farm workers. Certificates are issued. They are trained to recognize and record the incidence of pests, diseases and beneficials. This information is used to optimize control measures. The most outstanding elements of the project include the cooperation of all the key stakeholders, the distribution of written guidelines for production and quantification of adherence, and the optimization of chemical control measures (reduction of sprays e.g. acaricides). ■

→ *Source:* Bayer (PTY) Ltd.

National integrated policies

SUMMARY

Twenty cases have been selected to show how enabling policies have been implemented by governments at various levels to implement SARD.

Progress on SARD within Countries

Although almost every country would now say it supports sustainable agriculture the evidence points towards only patchy reforms. Only two countries have given explicit national support for sustainable agriculture – putting it at the centre of agricultural development policy and integrating policies accordingly. These are Cuba and Switzerland. Cuba has a national policy for alternative agriculture; and Switzerland has three tiers of support for both types of sustainable agriculture and rural development. Austria, Denmark, Sweden and Finland have given explicit national support for organic agriculture, but this has not necessarily impacted upon conventional farmers.

The Table below contains a summary of the types of support given by countries to sustainable agriculture, and the associated emergence of large-scale sustainable agriculture on the ground. Three countries have seen sub-regional support: three states in southern Brazil, with remarkable effect on zero-tillage and conservation farming; some states in India, particularly Rajasthan for watershed and soil management support and incentives for biofertilizers and Gujarat for policy on participatory irrigation management, with complete turnover to water users' groups.

A much larger number of countries have reformed elements of agricultural policies through new regulations, incentives and/or environmental taxes, and administrative mechanisms, and these are having considerable though partial effect. These include Kenya (catchment approach to soil conservation); Indonesia (ban on selected pesticides, combined with national programme for farmer field schools and IPM in rice); India (support for soybean processing and marketing); Bolivia (regional integration of agricultural and rural policies); Burkina Faso (Gestion de Terroirs land policy); Sri Lanka and Philippines (water users' groups for irrigation management). But none of these countries has yet explicitly put sustainable agriculture at the centre of their policy frameworks.

An even larger set of countries have seen some progress on sustainable agriculture at project and programme level – but this still remains largely despite, rather than because of, explicit policy support. Most reforms, though, remain piecemeal, with sustainable agriculture still largely at the margins of conventional policy processes and aims. No agriculture ministry is likely to say they are against sustainable agriculture, yet good words remain fully to be translated into integrated and comprehensive policy reforms.

Sustainable agricultural systems can be both economically, environmentally and socially viable, and contribute positively to local livelihoods. But without appropriate policy support, they are likely to remain at best localized in extent, and at worst simply wither away.

Selection of progressive policy reforms for sustainable agriculture according to degree of integration and observed outcomes

Countries with large-scale successes	Countries with significant localized successes
Countries with explicit national policy support for sustainable agriculture	
Cuba (national policy for alternative agriculture)	**Denmark and Sweden** (national support for organic farming; reduction policies for inorganic fertilizers and pesticides)
Switzerland (3 tiers of support for both types of sustainable agriculture and rural development)	**Finland** (agricultural and environmental scheme with incentives to farmers – 82 percent farmers joined)
Countries with explicit regional or provincial policy support (but not national)	
Brazil (zero-tillage and conservation farming in 3 southern states)	**India, Gujarat** (participatory irrigation management; complete turnover to water users' groups)
India, Rajasthan (soil management support, incentives for biofertilizers)	
Countries with supportive policy elements, but not integrated across agricultural sectors	
Kenya (catchment approach to soil conservation)	**The Netherlands** (pesticide reduction policies; nutrient regulations)
Paraguay (support for zero-tillage farming through matched central grants)	**Benin** (support for *mucuna* cultivation)
Indonesia (banned selected pesticides; national programme for farmer field schools and IPM in rice)	**Niger** (support for water harvesting)
India (support for soybean processing and marketing)	**India** (national participatory watershed management policy)
Bolivia (regional integration of agricultural and rural policies)	**Costarica** (conservation agriculture for sustainable development act)
Burkina Faso (Gestion de Terroirs land policy)	
Australia (national Landcare programme)	
Sri Lanka and the Philippines (water users' groups for irrigation management)	

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 percent of wheat, 90 percent of beans, 57 percent of all calories consumed, 94 percent of fertilizer, 82 percent of pesticides and 97 percent 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 emphasizes 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 1 300 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 2 800 tonnes of *Trichoderma* (used for biological control). 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 3 000 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:

- 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*);
- 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 2 000 people). In 1994, for example, *organoponicos*, *autoconsumos* and *huertos intensivos* were producing some 4 200 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 7 080 gardens (up from 2 500 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 caloric intake. This was 2 600 kcal/day in 1990, fell to some 1 000–1 500/day soon after the transition (with severe food insecurity), and has risen to an average of 2 700 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 Cubana de Agricultura Orgánica*, and formed in 1993). GAO brings 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 decentralization 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. ■

→ *Source:* Dr. Fernando Funes, Group of Organic Agriculture (GAO), Cuba – Apartado 4029, C.P. 10400, Havana, Cuba
Tel. 53-7-258862 Fax 53-7-286409 < mgahona@ip.etecsa.cu >

Switzerland: National policy for sustainable agriculture

The progressive Swiss policy reforms of the agricultural sector were made in the late 1990s – a radical package supported by 70 percent of the public in the 1996 referendum (Swiss Agency for Environment, Forests and Landscape, 1999). The Swiss Federal Agricultural Law was reframed in 1992 to target subsidies towards ecological practices, and then amended in 1996 as the 'Agricultural Act 2002', following a national referendum. Policy now differentiates between three different levels of public support depending on the sustainability of agriculture. Tier one is support for specific biotypes, such as extensive grassland and meadows, high-stem fruit trees and hedges. Tier two supports integrated production with reduced inputs, meeting higher ecological standards than conventional farming. Tier three is support for organic farming.

There are five minimum conditions necessary for farmers to receive payments for integrated production, the so-called 'ecological standard' of performance:

1. Provide evidence of balanced use of nutrients with fertilizer matched to crop demands and livestock farmers having to sell surplus manures or reduce livestock numbers.
2. Soils must be protected from erosion - erosive crops (e.g. maize) can only be cultivated if alternated in rotation with meadows and green manures.
3. At least 7 percent of the farm must be allocated for species diversity protection through unfertilized meadows, hedgerows, or orchards.
4. Use of diverse crop rotations.
5. Pesticides have to be reduced to established risk levels.

A vital element of the policy process is that responsibility to set, administer and monitor is delegated to cantons, farmers' unions and farm advisors, local bodies and non-government organizations. By 1999, 90 percent of farms were able to comply with the basic ecological standard (which allows them to receive public subsidies). Some 5 000 farms (8 percent) are now organic (up from two percent in 1991), and most farmers are now expected to meet the 'ecological standard' during the year 2000. Pesticide applications have fallen by 23 percent since 1990, and phosphate use is down from 83 to 73 kg/ha. ■

→ *Source:* Swiss Agency for Environment, Forests and Landscape (1990)

Subnational (province, state) and sectoral policies

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 Sul (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 percent over eight years (to 1999) to reach 3 750 kg/ha, soya up 83 percentto 2 730 kg/ha, and wheat up 82 percent to 2 125 kg/ha.

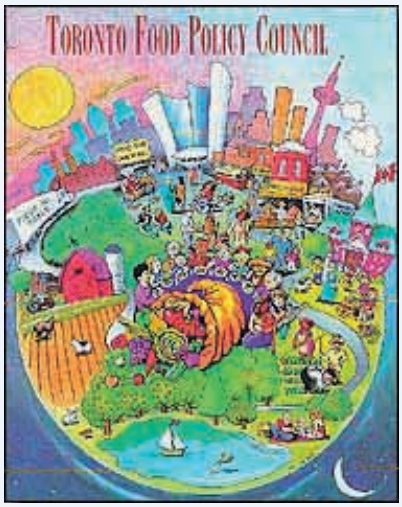
Like other ZT programmes, EPAGRI has documented improvements to water quality, soil health and water retention. Soils are darker in colour, spongy to the step, moist and full of earthworms. The reduced need for most weeding and ploughing has meant great labour savings for small farmers. From this work, 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 7 700 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. ■

→ *Source:* Dr. Gilmar Jacobowski, Technical Director, EPAGRI < gilmar@epagri.rct-sc.br >
Lauro Bassi < lbassi@epagri.rct-sc.br >

The Toronto Food Policy Council

Toronto Food Policy Council is an extended network of organizations concerned with food security, sustainable agriculture, public health and community development. The focus is on increasing low-income families' access to an affordable, nourishing diet and on fostering food micro-enterprises involving low-income people. It was set up in 1990 to bring together professionals and activists from a wide range of sectors: public health, farm and rural, food, labour, education, community, and hunger advocacy.



The FPC receives support from the City Council, and is administered by the Department of Public Health. This gives it formal credibility, whilst allowing it to work with many community groups. It has two key roles: the removal of public policy impediments which limit access to decent levels of nutrition; and the creation of progressive policies which promote community action on food issues. At the time of the emergence of the FPC, Toronto was characterized by economic decline, a rapid shift from permanent to part-time and short-term jobs, increased dependence on social services, ingrained poverty in certain groups combined with increased poverty in lower-middle classes, and increased numbers of people hungry. During the 1980s, food banks emerged in response to the dismantling of social security safety nets, growing to more than 400 in number by the 1990s. A total of 150 000 residents use food banks each year, and on average each receive US$10 worth of food every month. But food banks were also recognized as only a stop-gap that focused on the symptoms of hunger rather the underlying causes.

The FPC set out to shift the food, welfare and public health systems from their emergency focus to give them a greater role in improving community self-reliance and social capital. One example of the FPC programme is the Field to Table Program, which arose from a partnership between community groups and Ontario farmers. It has three modes of food delivery: under the Good Food Box, families can buy a box of fresh fruit and vegetables each month; from community markets, individuals can purchase fruit and vegetables and sell them locally; and in the Buying Clubs, community members can order fresh fruit and vegetables and have them delivered.

The Good Food Box has been particularly effective. It targets people who wish to buy fresh foods, are on low incomes, have disability or health problems and/or are senior citizens. Between 1 500 and 2 500 boxes per month were delivered in 1997, mostly to customers on low income, including a sizeable proportion of single parent mothers. The impacts have been on many parts of the food system. Some 70 percent of those buying food boxes now eat more vegetables; 21 percent eat a greater variety; and 16 percent now try new foods. More people also know about the recommendation that we should eat five or more servings of fruit and/or vegetables per day. At the start, a quarter of food in the food banks was sourced from Ontario farmers; by 1996 it had grown to 95 percent. Even more interesting, a substantial number of GFB recipients said the scheme was affecting their social contacts. More than a fifth said the scheme had made them more community oriented. Other less tangible effects of the whole Field to Table scheme have been noted, such as in schools where there is better attendance, less tardiness and better socialization in classrooms. The Field to Table programme reaches 10 000 people.

Other benefits of the FPC's work include the rapid growth in community gardens in Toronto, the support now given by provincial government to provide massive help for schools' food programmes, and the wider impacts on policy processes. It has also been promoting local economic renewal through a wide range of institutions and sectors, including ecological tax reform, health care reform and agricultural policy reform. ■

→ *Source:* Rod MacRae, Food Policy Consulting < rmacrae@ican.net > – < www.realfoodhome.net >

Germany: Regional support from the Länder

In Germany, regional schemes developed by the Länder (regional governments) pay farmers not to damage the environment. To 1997, some 200 000 farmers had joined the schemes, covering some 17 million hectares, about a tenth of total agricultural area. To date, the main uptake has been for extensive grassland management, about 80 percent of the total. However, some states have made important steps towards positive environmental management.

The MEKA (Marketentlastungs und Kulturlandschaftsausgleich) cheme of Baden-Würtemburg gives farmers an 'à la carte' menu of technologies from which to choose, each one earning them 'eco-points', and each point brings them DM20 per hectare. For example, using no growth regulator attracts ten points; sowing a green manure crop in the autumn earns six points, applying no herbicides and using mechanical weeding gets five points; cutting back livestock to 1.2-1.8 adult units per hectare brings three points; and direct drilling on erosive soils earns 6 points. Direct environment protection measures include up to fifteen points for reduced stocking on areas designated as of special scientific interest and points can also be earned for keeping rare breeds.

The national cost of the scheme is split between the Federal government and the regional government, with the CAP picking up the rest under agri-environment regulation. By 1997, 102 000 farmers had signed up, with the result that 220 000 hectares of grassland is now managed extensively, 225 000 hectares of arable is also managed extensively, with a considerable proportion no longer using pesticides or fertilizers, 97 000 hectares of protected vineyards and orchards. But only 2 300 hectares of land has been entered for positive nature conservation, such as new hedge planting or riverine management. Some 14 000 hectares, however, have become organic.

In Hessen, some 82 000 hectares are farmed under the HEKUL (Hessiches Kulturlandschaftaprogramm) programme, which is extensifying farming and encouraging the adoption of organic farming technologies. In Rheinland Pfalz, the FUL (Förderprogram Unweltschonende Landbewirtschaftung) Programme includes payments for organic production, low-input integrated practices, and extensified grassland farming. ■

→ *Source:* Pretty (1998). The Living Land

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 recognized 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 percent to 450–925 kg/ha. ■

→ *Source:* FAO

The National Irrigation Administration of the Philippines

The National Irrigation Administration of the Philippines' government seeks to establish irrigators' associations (IAs) to sustain the operation and maintenance of small-scale irrigation systems that have received construction assistance from the government. These small-scale systems are generally less than 1 000 ha, but cover about half of the country's irrigated lands. The remainder are government-owned and operated.

During the 1960s and 1970s, the NIA approach was distinctly non-participatory. Engineers planned infrastructure, and systems were built with only nominal local consultation. Systems often fell into disrepair, as farmers saw little reason to take on management responsibilities. During the 1980s, though, the NIA adopted a participatory approach to irrigation.

Fundamental changes were made in the NIA to support this new participatory approach. These included the introduction of motivated, mostly female, community organizers; the reorientation of site assessment procedures to reflect locally-diverse conditions; the devolution of authority to make the provincial irrigation engineers responsible for overall coordination of irrigation programmes in their respective provinces; and the strengthening of agency accountability to water users.

The approach to institution building was also fundamentally different. In the non-participatory approach, farmers were expected to form IAs only shortly before construction began, when NIA personnel called farmers together to elect their officials. The participatory approach, by contrast, focuses on the association months before construction starts. Full-time organizers reside in the project area and prepare local people to work with the engineers. The organizers also continue to work with the association for at least two crop seasons under the improved system. Farmers are now involved from the very start of the project, including determining the layout of the proposed system, and constructing dams, canals, and structures. Once the construction is completed, the NIA turns over full authority for the systems to the IAs.

The NIA developed their participatory approaches experimentally over time. This meant that participatory and non-participatory efforts continued side-by-side, and it has been possible to measure the impact of the participatory element alone. The primary impacts include: rice yields increased by 19 percent in wet seasons and by 16 percent in the dry; farmers contributions to costs increased from 54 to 357 pesos/ha; an increase from 27 percent to 83 percent in systems in which farmers' suggestions were incorporated in design; a fall by half in the number of NIA-built canals abandoned or rerouted; an increase in association members present at the turnover ceremony; an increase from 50 percent to 82 percent in remittance of amortization payments within a year; an increase in time farmers contributed to group maintenance of systems; and an improved capacity of IAs to manage their own affairs. ■

→ *Source:* National Irrigation Administration, Philippines

Solomon Islands: Vocational training in rural training centres

The Solomon Islands are an archipelago of about 900 islands, many of which of difficult access and with limited services and resources. Rural communities' lifestyle has long been based on subsistence agriculture, artisanal fisheries, forest harvesting and inter-community trade. The expansion of cash economy and the increased exploitation of natural resources (cash crops, timber, tuna) by non-residential entrepreneurs has enhanced exodus to "urban" areas, development gaps for rural dwellers and social conflicts. The lack of credit facilities, equipment, materials and technical skills has limited the development of smallholders' initiatives and rural businesses. In the early 90's, based on community, cultural and/or religious relationships, some 30 rural associations have been spontaneously established; called Rural Training Centres. Their main roles were to provide advise, technical assistance, vocational training and access to credit.

The 30 RTCs (more joined the association during the project implementation) supported 10 to 30 initiatives in their area of interest. Some trainees became trainers themselves, finding part-time employment in the RTCs. New trading facilities and commercial routes were established in the areas of production, creating new jobs opportunities. New branches of the Development Bank have been established in particularly dynamic provinces.

The key impacts include:

- combating poverty through self-employment and entrepreneurship and limiting exodus to urban areas;
- managing land sustainably through support is given to design and implement the initiatives based on improved traditional knowledge, environmentally sound techniques, local resources available and social needs of the concerned communities;
- sustainable agriculture through increased and diversified use of customary land with better return for local communities: strengthened role of local leadership; added value to local products through direct involvement in commercialization and processing; increased social development through new trade and services facilities.
- Benefits to women in sustainable development through approval of many applications from women – the most common fields of intervention for women were sewing, food processing and poultry.
- partnerships with NGOs – the RTCs are community-based NGOs and are participating directly to the definition of the role and activities of their association and to the decision-making process.
- financing sustainable development – the credit scheme is recording a good rate of success with loan repayment procedures generally in line with the type of investment.

United States of America: Support to farmers' markets

In the United States, farmers' markets have emerged on a huge scale in recent years. Under the Federal 1976 Farmer-to-Consumer Direct Marketing Act, state extension services have a mandate to promote the development and expansion of direct marketing. Held on a weekly or twice weekly basis, farmers and consumer groups have established new market sites to foster direct selling to the local public. There are at least 2 400 farmers' markets in the United States of America, involving more than 20 000 farmers as vendors, one third of whom use them as their sole outlet. Each is unique, offering a variety of farm-fresh and organic vegetables, fruits and herbs, as well as flowers, cheese, baked goods and sometimes seafood. Each week, about one million people visit these farmers' markets, 90 percent of whom live within 11 km of the market. The annual national turnover is about one billion dollars.

The benefits these farmers' markets bring are substantial - they improve access to local food; they improve returns to farmers; they also contribute to community life and social capital, bringing large numbers of people together on a regular basis. Consumers also perceive the food to be of better quality and cheaper than in supermarkets. One piece of research on fifteen farmers' markets in California found that produce was 34 percent cheaper than in supermarkets. The contributions to local economies are substantial. One farmers' market in Madison, Wisconsin contributes 5 million US dollars to the local economy each year; another in Santa Fe, New Mexico brings an added 0.75 million US dollars to the nearby farming and food system.

The evidence also seems to suggest that farmers' markets have a largely positive impact on other local businesses and enterprises, as they increase foot traffic and visibility. There is no evidence that they remove business from other shops. Farmers' markets also recycle resources into other important community functions, contributing particularly to social capital. In Los Angeles, for example, the Encino market is sponsored by an organization that provides for the elderly, and part of the revenue from the market goes back into health care. Markets run by the Georgia Hunger Coalition bring black farmers from rural south Georgia into black housing estates of Atlanta to sell their produce to 300 households. And in New Orleans, the Viet Namese market features a wide range of Asian vegetables and ducks raised on 16 hectares of former wasteland. ■

→ *Source:* < http://www.usda.gov > – < http://attra.ncat.org/attra-pub/farmmrkt.html >

Integrated pest management

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 2 600 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 (e.g. *Trichogramma*, neem) means that conventional pesticide use has fallen by 50 percent on average. Incomes have increased by Rs 1 000–1 250/ha, and rice yields have increased by 250 kg/ha. ■

→ *Source:* Kenmore (1999)

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:* Kenmore (1999)

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 4 300 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 percent for rice, and 7–44 percent for vegetables, depending on location in the country. ■

→ *Source:* Jones (1999)

Viet Nam: IPM in rice in Mekong Delta

Researchers with the International Rice Research Institute, Ministry of Agriculture and Rural Development (Viet Nam) 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, Viet Nam. 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, organized 1 390 demonstrations and broadcast a radio drama 1 550 times. This reached 97 percent of the 20 000 farmers in the study region, and 82 percent 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 percent had stopped early season spraying, and 20–30 percent had stopped using insecticides altogether.

Other provinces in the Mekong Delta adopted the approach, and their campaigns have reached 92 percent of the 2.3 million farmers – who have now reduced spray frequencies to one per season (a 70 percent 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. ■

→ *Source:* K.L. Heong, International Rice Research Institute, MCPO Box 3127, Makati City 1271, Philippines < k.heong@cgiar.org >

Soils and land management

Brazil: Zero-tillage in large-scale farms in Paraná and Rio Grande do Sul

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 do Sul. These have been organized into 2 100 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 organized into some 8 000 Friends of Land Clubs, which are organized at many different levels – local, municipal, multi-municipal, river basin and state.

The model of ZT is unlike that adopted in industrialized countries, particularly in the United States, 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 percent drop). Maize yields have improved by 67 percent from 3 to 5 t/ha in a decade and soya by 68 percent 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 factors that stimulate 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*". ■

→ *Source:* John Landers < john.landers@apis.com.br >

Malawi: Agroforestry extension project (MAFE)

This participatory extension project work with some 20 000 farmers on 4 200 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 (e.g. *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 organizations 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 1 500–2 000 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 1 155 913 households, and the project expects to see reduced pressure on natural forests as these mature. ■

→ *Source:* Zwide Jere, MAFE project

Economic instruments

Europe: Environmental taxes in agriculture

Environmental or 'eco' taxes seek to shift the burden of taxation away from economic 'goods', such as labour, towards environmental 'bads', such as waste and pollution. The market prices for agricultural inputs and products do not currently reflect the full costs of farming. Environmental taxes or pollution payments, however, seek to internalize some of these costs, so encouraging individuals and businesses to use resources more efficiently. Such green taxes offer the opportunity of a 'double dividend' by cutting environmental damage, particularly from non-point sources of pollution, whilst promoting welfare.

There is still, however, a widespread view that environmental taxes stifle economic growth. Growing empirical evidence on the costs of compliance with environmental regulations and taxes suggest that there have been little or no impact on the overall competitiveness of businesses or countries, with some suggestion that they have increased efficiency and employment.

Although there are a wide variety of environmental taxes and levies in countries of Europe and North America (e.g. carbon/energy taxes, CFC taxes, sulphur taxes, NO_2 charges, leaded and unleaded petrol differentials, landfill tax, groundwater extraction charges, and sewage charges, environmental taxes have not tended to be applied to agriculture. The notable exception is pesticide taxes in Denmark, Finland, Sweden and in several states of the United States of America; fertilizer taxes in Austria (1986-94), Finland (1976-94), Sweden, and again several states of the United States; and manure charges in Belgium and the Netherlands.

The ideal situation for a pesticide tax is for the highest costs to be imposed on products causing the most harm to environmental and human health. However, there is no accepted methodology for hazard ranking. There are various options, including a banding system, with pesticides grouped into classes with similar impact, and an ad-valorem or kg-based tax, with tax as a proportion of price or imposed on pesticide use. An important question remains on what happens to farmers' behaviour following the establishment of a pesticide tax. In particular, if prices increase, will use of pesticides fall? The price elasticity of demand is important for determining such environmental effects, and estimates from the Netherlands, Greece, France, Germany, Denmark and the United Kingdom put it generally between -0.2 and -0.4, with a few ranging up to -0.7 to -1.0. This seems to imply that it will take a large price change for farmers to change their practices – inelastic demand limits environmental effectiveness, though it is good for generating revenue.

But, there are several reasons why elasticity is probably higher. First, demand is inelastic if there is an expectation that price rises will quickly be reversed – but if farmers come to accept that higher prices incorporating the environmental taxes will remain in place, then further behaviour changes will occur. Second, a well-designed package of taxes with regulations, advice and incentives can increase price responsiveness. And third, as innovation increases, more sustainable agriculture options become available to farmers, so promoting further change.

Where taxes have been established, they have been levied on sales price or kg of active ingredient used. These taxes vary from 0.7 percent of sales price (USA) to 36 percent (Denmark), and have different effects – at best a 65 percent reduction in pesticide use in Sweden since 1985. Revenue raised ranges from £37 (US$59) million per year in the United States (of which 24 percent is from California alone), £12.5 (US$20) million in Norway, and £0.9 (US$1.5) million in Sweden. Fertilizer taxes have been introduced in several countries, and are currently of the order of £0.06–0.25 (US$0.1–0.4) per kg of nitrogen, phosphorus and potassium in Austria, Norway and Sweden, though much lower in the United States: £0.0004–0.0125 (US$0.0006–0.02)/kg N in various states). Most agree that tax packages having the greatest impact on externalities are those combined with other policy instruments (advice, incentives and regulations) and that are hypothecated – with the revenue raised being reinvested solely in promoting more sustainable alternatives. ■

→ *Source:* Pretty (1998); Ekins (1999)

Support for farmers' associations and groups

Australia: National policy for landcare groups

One of the best examples of rural partnerships comes from Australia, where a remarkable national social experiment has been underway since the 1980s. Landcare encourages groups of farmers to work together with government and rural communities to solve a wide range of rural environmental and social problems. By the end of 1998, there were 4 500 active local groups, comprising more than a half of all Australian farm families. For a country where individual farmers have prided themselves for so long with 'frontier' spirit, and capacity to cope alone with problems, this is an extraordinary society-wide recognition that some problems can only be dealt with by working together.

Landcare groups have emerged to deal with many different local problems that affect the whole community. Groups deal with pest, weed and rabbit problems; with tree decline; with dune regeneration; with conservation farming; with soil salinity; with wildlife conservation; and with farm profitability and business management. One example is the Morbinning Catchment group from the wheat belt of Western Australia. The Morbinning Catchment consists of twenty families on 25 000 hectares of farmland. They formed the group in 1989 united by their common problems of increasing soil salinity, poor drainage and the effects of periodical flooding. These problems could only be dealt with by planning and cooperating across farm boundaries. Over eight years, the group has revegetated 300 hectares of creeklines; treated 550 hectares of saltland; planted 440 000 trees including 91 km of windbreaks and 90 hectares of fodder trees; erected 249 km of fencing to protect natural bush; planted 460 hectares of alley farming systems and 80 hectares of permanent pastures; and installed 145 piezometers so as to measure regularly the water table depth. The group have also been at the forefront of local farm improvements, including in oil seeds, reduced tillage, alternative fertilizers, soil aeration, floriculture, sandalwood planting, and farm stays and school visit programmes. ■

→ *Source:* Pretty (1998) < http://www.landcareaustralia.com.au/default.htm >

India: Water users' associations 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.

Pakistan and India: Micro-Finance for Local Groups

In the remote Northern Areas of Pakistan, the Aga Khan Rural Support Programme has helped to establish more than 2 600 village or women's organizations, which cater for some 53 000 households. Village groups first organized to help construct an irrigation channel, road or bridge, then help members regularly to save small amounts of money and so create collateral for credit provision. Over time, and with local control and responsibility, groups have been able to save substantial sums.

Other notable successes have emerged in southern India, where NGOs such as Myrada, SPEECH and Pradan have again shown the value of small groups. Years of relying on banks and local cooperative societies to supply credit had rarely helped the poor. But when they started to work with small independent groups with members feeling they could trust one another, they noticed that not only was the money managed more carefully, there was a far greater commitment and responsibility from the groups towards repaying the amount of money, something that had not unduly bothered them when they were part of the cooperative. What is particularly significant for the programmes is that some 95-98 percent of loans are repaid in full. This contrasts with just 20–25 percent for banks making loans under Integrated Rural Development Programmes. ■

→ *Source:* Pretty (1995)

Improvements in women's and children's status

Kenya: Benefits to children's health and nutrition

SUMMARY

Eleven cases have been selected to show the positive rural development outcomes that arise from the implementation of SARD.

The Association for Better Land Husbandry (ABLH) promotes low cost methods of conservation-based farming that reduce poverty, improve rural people's livelihoods and boost rural economies. The approach 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. Double dug beds combined with composting, green and animal manures improve the soil. Good 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 is done for the next 2–3 years. Many vegetables and fruits are cultivated, including 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 group members. Children have been major 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 percent of households are now free from hunger during the year, and the proportion of households buying vegetables has fallen from 85 to 11 percent. ■

→ *Source:* Jim Cheatle, ABLH, Kenya < jcheatle@net2000ke.com >

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 fertilizer 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. ■

→ *Source:* Carolee Black, HPI

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 percent) 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.

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 stabilized 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:* Intermediate Technology Development Group

Rural Jobs and Migration Patterns

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 one metre over the past 34 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:* P.S. Sodhi, GVT, Udaipur < gvtudr@bppl.net.in >

Italy: Multifunctional olive cultivation contributes to local jobs

Olive trees have been cultivated for at least two millennia on the Mediterranean coast, contributing to local livelihoods and producing rich and varied habitats for wildlife. But over recent decades, Cilento has suffered from mass emigration, with the young no longer wanting to be olive farmers. Combined with competition from Tunisia, where production costs are lower, pressures on the system are growing.

The CADISPA project coordinated by the University of Strathclyde works closely with local groups in a range of countries to support local regeneration. In Cilento, CADISPA-Italy began working with a local olive oil cooperative, Nuovo Cilento, to introduce organic farming and new marketing methods. Now 130 farmers located in the national park of Cilento are fully organic, using a wide range of resource conserving practices to minimize input use and recycle valuable products, such as using olive husks for fertilizer. They now produce Cilento verde, an extra virgin organic oil of high value. Since the successful regeneration of olive production, cooperative businesses have now been set up for wild chestnut flour production, and ecotourism. These new ventures are largely run by young people, who are increasingly opting to stay in Cilento and use their abilities and skills to develop high quality local goods and services. ■

→ *Source:* Pretty (1998). The Living Land

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 organization and hard work, ISMAM was able to capitalize 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

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 5 800 ha of abandoned and degraded lands on the farms of some 6 000 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 700–1 000 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. In the case of tassas they rise to 400 kg with manure in a poor rainfall year, and 700–1 000 kg/ha in a good rain year. Addition of some fertilizer increases yields again – to 650 kg/ha in poor years and 1 400–1 500 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 percent and 40 percent, 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. ■

→ *Source:* Alberta Mascaretti, IFAD; Reij (1996)

United States of America: Green enterprises in Willapa Watershed of the Pacific Northwest

In recent years, the protection of either local jobs or the environment have been on collision course in the Pacific North-West. Bitter disputes have erupted over the spotted owl: after it was declared endangered in 1990, the volume of timber harvested in Oregon and Washington fell by a half. But now, new partnerships between formerly hostile groups have emerged, showing just how much sustainable management of natural resources and agriculture can contribute to local economic growth.

The Willapa watershed comprises 275 000 hectares on the coast of Washington state. It is rich in natural resources, including oysters, clams, crabs, sturgeon, salmon and dense forests. But the four counties that comprise the watershed are extremely poor, and are listed as 'economically distressed' by the state. In addition, natural resources have become diminished: salmon runs have dwindled, sturgeon have almost disappeared, oyster size has fallen, and old growth forests have been replaced by plantations of firs. There is a close connection between the state of resources and local poverty – resources were harvested and shipped out, with few jobs and little income created en route.

The challenge was to create businesses and products that made sustainable use of natural resources and also added value to them. Ecotrust, an environmental group based in Portland, helped to form a new partnership of farmers, oyster growers, fishermen, small businesses, native American groups and others. This 'Willapa Alliance' commissioned studies on resource use and assets, and developed a joint management plan. It was clear that many business ideas existed, but skills and access to markets and credit were in short supply. Ecotrust then contacted a well-established community bank in Chicago, the South Shore Bank, which had invested US$345 million in low-income neighbourhoods for community regeneration since the 1970s. With the support of the Ford Foundation and the SSB, the Willapa Alliance market tested development banking for the watershed. Help has now been given to a range of local businesses that add value to natural resources, including:

- Willapa oysters that are now marketed locally rather than shipped out wholesale;
- cranberry growers who now produce a wide range of products - all cranberries used to be transported out;
- mushrooms which are collected from the forests for sale;
- alder which is harvested from secondary forests for high quality wood products;
- fish and crab which is marketed with the NW image of wholesome foods;
- interweaving of *Spartina* grasses with denim to make women's summer shoes (*Spartina* is a weed of shellfish beds and otherwise would be controlled with herbicides).

Many of these have helped local people to make a new livelihood, including the Shoalwater Bay Tribe, who now have formed an oyster company and harvest from 300 hectares of tidal beds. After several years of growing success, a new platform has emerged. The Willapa Economic Development Task Force has now designed an ambitious regional development plan based on sustainable use of natural resources. ■

→ *Source:* Pretty (1998). The Living Land

Dietary and reproductive health

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

World Neighbors has been working in the high mountains of Bolivia (2 800-4 000 masl) in Northern Potosí on improving potato productivity since 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 200/1 000; maternal mortality 100/1 000, 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 2 000 farmers have improved potato production from about 4 000 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 2 800 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 1 780 kg/ha to 8 500 kg/ha with lupins, and rose to 13 000 kg/ha when sheep manure was also incorporated. The cash outlay for lupins is US$18/ha, which compares with the US$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 percent, 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, pers. comm. Ruddell (1995)

China: Rice-fish systems benefit health in Jiangsu Province

Rice-fish culture offers many multifunctional 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 million 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 5 000 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 percent over a ten year period. ■

→ *Source:* Li Kangmin (1998)

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 southwest 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 5 000 ha, resulting in a 70 percent improvement of overall nutrition levels within the project area, along with a 60 percent 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

Regional Biodiversity Improvements

SUMMARY

Ten cases have been selected to show the wider environmental outcomes that can arise from the successful implementation of SARD.

El Salvador: Promotion of biodiversity conservation within coffee landscapes

This project involves conservation of biological diversity through the maintenance and enhancement of habitats within shade-coffee plantations in a biological corridor linking two protected areas; enhancement of income for farmers producing bio-diversity friendly coffee; and the creation of a bio-diversity friendly coffee export industry.

The project seeks to conserve critical bio-diversity in El Salvador through the maintenance and enhancement of habitats within shade-code plantations in the biological corridor linking El Impossible and Los Volcanes protected areas. The Corridor would cover roughly 75 000 ha, and has been identified as one of the most important national corridors in terms of biodiversity, as well as a strategic link in the regional Mesoamerican Biological Corridor. El Salvador is a country where severe environmental degradation has taken place. Only two percent of the original forest cover remains under natural conditions, and many remaining lands are degraded or eroded because of unsustainable land use practices. Therefore, the establishment of additional protected areas is not a viable alternative for conserving biodiversity over large areas. Restoring degraded land and enhancing productive landscapes for biodiversity conservation are therefore necessary steps for achieving biodiversity conservation. Project outcomes include: a) increase of the areas cultivated under shade coffee using biodiversity friendly practices from the current baseline; b) initiate the establishment of a biological corridor of shade coffee habitats linking protected areas; and c) creation of incentives for biodiversity friendly coffee export industry in El Salvador. ■

→ *Source:* IPGRI

Estonia: Integrated management of Matsalu wetland

This project involves the reestablishment of the mowing of traditional semi-natural hay meadows, stopping the decline in grazing intensity of traditional coastal pastures, and involves some 100 households on 4 000 hectares. The Matsalu Wetland of International Importance is situated in Western Estonia. Most of its habitats have been affected by human action – including mowing, grazing, etc. as well as forest clearing and reed harvest. Semi-natural communities are among chief values of the wetland. Measures to counteract abandonment of the meadows are therefore given high priority in the Management Plan for Matsalu Wetland. These include mainly grazing or mowing contracts with the farmers and paying compensations according to these. Management has now been carried out for three years according to the Plan. Additional measures not included in the actions proposed in the Plan but contributing to its goals have been investments in machinery available to farmers. Negative trends have been slowed down but more work remains to be done. The most outstanding results are that the mowed area has been restored to 2 000 hectares, the decline in grazing intensity has stopped, the technical capacity to use the meadows has been enhanced, and there is now mutual understanding between nature conservation authorities and the farmers. ■

→ *Source:* Pretty (1998). The Living Land

Greece: Organic agriculture in Prespa National Park

The Prespa National Park is close to the borders of Albania and Macedonia. It comprises a montane valley with two lakes and their surrounding floodplain. It is the home to the largest nesting colony of Dalmatian Pelicans (*Pelecanus crispus*) in the world. The area is remote, with the main economic activity being farming of beans, with some livestock and fishing to supplement incomes. The traditional land management system has been important for natural capital, as livestock graze the wet meadows and keep down the reeds, so creating valuable habitats for birds and fish. But adoption of intensive cultivation methods for the beans led to the conversion of some meadows to arable, and a big increase in fertilizer and pesticide use. Both of these have had a significant impact on the aquatic resources, and the consequent loss of spoonbills and glossy ibis. In 1993, various organizations began to promote organic bean cultivation, the diversification of agriculture, and the development of the wildlife tourism potential of the park.

Farmers are now getting higher bean yields, as well as premium prices. This is encouraging more to adopt sustainable practices. With the focus on ecotourism, the number of visitors to the park has increased from 5 300 to 13 000. These visitors are better spread throughout the year. Young people from the communities have been trained in environmental management, and two tourism centres have been opened. These have helped to change local attitudes to conservation as well as those of visitors. The growth in ecotourism has prompted the establishment of two guest houses run by local women and several restaurants and tavernas have benefited from increased spending by visitors. Some 50–60 people are now employed in the ecotourism sector. The government has also helped by investing in infrastructure for ecotourism and Multifunctional agriculture. ■

→ *Source:* Pretty (1998). The Living Land

Spain and Scotland: Agricultural systems that benefit bird biodiversity

The *dehesas* are highly integrated systems contributing significantly to both natural and social capital. The term *dehesa* refers to a mix of woodland pastures and open grassland, dominated by holm and cork oak, with cereal crops and livestock – sheep, cattle, pigs and goats – feeding on grass and acorns. These are highly integrated systems, with the trees providing charcoal, firewood, shade, acorns and cork; the cereals providing grain and fodder; and the animals providing livestock products (meat and milk). There are usually 4–20 year rotations for arable practices, so the whole landscape is a mosaic of mixed habitats.

They are very rich with wildlife: up to 60 plant species per square metre, butterflies, birds and animals, including threatened species such as Spanish Imperial Eagle, Egyptian Vulture, Black Stork and Iberian Lynx. *Dehesas* are also important sources of employment for local people when managed properly. For example, one 7 000 ha estate in Andalucìa produces cork, timber, firewood, livestock (sheep, deer and cattle) and wild plants (herbs and fungi). The arable and grassland systems are low-input, and there is high labour use. This is higher than neighbouring estates not managed in an integrated fashion. But many of these areas are now in decline, with trees removed for more intensive and large-scale agriculture or land given over to reafforestation with pines and eucalyptus.

Much the same is true of biodiverse habitats in Scotland. Long-term research on the island of Islay in the Inner Hebrides has revealed again the crucial role of a complex and diverse landscape for bird life. Islay has nine important bird species: barnacle goose, chough, corncrake, golden eagle, golden plover, hen harrier, merlin, peregrine falcon and white-footed goose. By dividing the island's semi-natural and agricultural systems into eight types, and classifying all 687 one kilometre squares, it was found that different species use different land types at different times of the year. It

was the mosaic that was crucial: "*one of the most important features [is] ... how all of the land types are selected at some time in the year. Consequently we concluded that it is the diversity of land types that supports such a large number of bird species*". It is clearly not simply a question of maintaining one or two habitats or remnants amongst intensive farmland. Whole landscapes need to be protected by mixed and sustainable farming practices. And what is good for birds is good for people. ■

→ *Source:* Diaz *et al.* (1997); Cuff and Rayment (1997); Bignall and McCracken (1996)

United States of America: The Darby Watershed Project, Ohio

The Darby Project in Ohio is a collaborative effort funded by the WK Kellogg Foundation to preserve, enhance and maintain some 163 000 hectares of watershed and its diverse ecological and farming systems. A wide range of government, non-government, private and community groups are working together to change attitudes and practices of both farmers and local people. The watershed is primarily farmed – some 80 percent is farmed intensively to produce maize and soybeans, with little grassland, legumes or small grains as ground cover. Some 10 percent of the watershed is poor quality pasture. Urbanization is rapidly consuming large portions of agricultural land. Both modern farming and urban sprawl are threatening a biologically-rich landscape: there are 86 species of fish and 40 species of freshwater mussels in the rivers and creeks, plus 104 species of birds, 35 of mammals, and 33 of reptiles and amphibians; more than 25 endangered species of plants are also found.

Conservation activities are not new to the area. Authorities have been trying to promote soil and water conservation in farming since the 1940s. What is new, though, is the way that many agencies are now collaborating to solve conservation problems on a whole watershed basis. This means involving not just farmers, but also leisure users and environmental and community groups. Nearly 5 000 children are now involved in stream quality monitoring programmes; others are engaged in labelling storm drains to discourage household waste dumping; group walks are organised for keen naturalists; households are encouraged to manage their lawns and gardens sustainably; families are urged to get involved in local planning and decision-making.

There has been progress on the farming front with the formation of a group called the Operation Future Association. This began with twelve farmers, and has now grown to 170. Many felt stuck in the old type of farming, and needed help to begin to take small steps towards sustainability. As Wes Beery put it "*the most common thing I hear now is 'what methods can I use to farm in an environmentally benign way and what can I do to reduce chemical inputs*". The hope is that as these farmers make progress, so more in the watershed will be exposed to their approaches and technologies, so increasing the impact on the watershed as a whole. To 1996, one third of farms in the watershed had implemented land conservation plans, 18 new wetlands had been created, and a reduction of sediment load of 35 000 tonnes per year recorded. ■

→ *Source:* Pretty (1998). The Living Land; Wes Beery, pers. comm.; Darby Project reports

Wales: The Red Kite Project

The Red Kite project is an example of how wildlife tourism and appropriate farming can stimulate a rural economy. Mid-Wales, comprising north and west Brecknock, north Dinefwr, Ceredigion, south Montgomeryshire and west Radnorshire, is an area of low wages, declining employment in agriculture and economic stagnation. It is also an area that supports remnants of the native population of Red Kite, a rare bird of prey. Agriculture is heavily dependent on livestock farming. The population density is low, and the rural population is ageing.

The Kite Country Project was launched as a partnership of County and District councils, the RSPB, CCW, Wales Tourism Board, Development Board for Rural Wales, Mid-Wales Tourism and Forest Enterprise in 1994. It is supported by Objective 5b money, the Welsh Office and private sector sources. The aim is to increase tourism to the region, promote wildlife and the environment, introduce a wider public to the area, and encourage them to stay longer and so spend more in the local economy. The project has set up six visitor centres; promoted public transport, cycling and walking; installed remote video technology and special feeding stations so that the birds can be observed without disturbance; set up interpretation panels; developed community partnerships for green tourism; and promoted a stay-on-a-farm scheme with 130 farms as participants.

The impacts have been substantial. In 1995-96, there were 148 000 visitors to the Kite Country centres. They spent £5.4 million in the mid-Wales economy during these visits, about half of which has been attributed to the presence of the kites. A third of the visits are during winter, formerly a very low season for tourism. People who come tend to stay longer and come back more often. The project has created and/or safeguarded 114 FTE jobs in the local community, and created a further 14 directly through employment of staff and contractors. 1995 was also the best breeding year seen for the Red Kite, with 120 pairs fledging 112 young. ■

→ *Source:* Rayment (1997)

Water quality and quantity improvements

Sri Lanka: The rehabilitation of Gal Oya Irrigation Scheme in Sri Lanka

In 1980, the Sri Lankan government's Irrigation Department, the Agrarian Research Training Institute (ARTI), and the Cornell Rural Development Committee began working with small-holder farmers in the Gal Oya irrigation scheme. At the time, this was the largest and most run-down scheme in Sri Lanka. The approach to rehabilitation was to place young community organizers in the field, who would encourage farmers to form water users' associations, so that they could solve irrigation problems for themselves. The historical context was one of 30 years of conflict and non-cooperation. A senior official in the Irrigation Department said "*if we can make progress in Gal Oya, we can make progress anywhere in Sri Lanka*".

The organizers were recruited and trained by ARTI to live and work in the communities, with the primary objective of ensuring that all plans were the farmers' own. Water users' groups were formed, but not forced on farmers. The organizers, also called animators, promoters or motivators, worked as catalysts to stimulate and nurture local organization. The usual approach to establishing rural organizations (calling a meeting, passing a constitution, and electing officers) was known not to lead to sustainable organizations. Here the approach was to let groups evolve, beginning first with problem identification and collective action, which could lead to formal organization later. The process brought forth more tested and altruistic leadership, who had solid support amongst their members.

The project has rehabilitated 10 000 ha, with benefits exceeding costs by a ratio of 1.5 to 1. The economic benefits of the project depend primarily on increased water use efficiency, which enabled farmers to increase their cropping intensity and thereby raise production. There were also some increases in yields. These changes in the efficiency and equity of water use have been dramatic and long lasting. The number of complaints received by the Irrigation Department about water distribution fell to nearly zero, as adjustments were made by farmers and field-level staff. Before the project, 80 percent of channel gates were broken; afterwards this problem practically disappeared. Farmers' organizations have maintained themselves, progressed institutionally, and developed their own capacity for dealing with problems.

Farmers' organizations, once established, have used their new capabilities to deal with many other needs, such as crop protection, credit supply, settlement of domestic disputes, land consolidation and reducing drunkenness. Bureaucratic reorientation has been essential for success. This has been promoted amongst engineers and officials by demonstrations of farmers' knowledge and ability to achieve unexpected improvements. This iterative process has been crucial: "*displays of initiative and intelligence by farmers gained some respect from officials, and this in turn encouraged farmers to show more capability, which again increased the respect accorded them by officials*" (Norman Uphoff).

The value of social capital was showed in 1998 during a drought. According to the government, there was only enough water for irrigation of 4 900 ha of rice, but farmers persuaded the Irrigation Department to let the water through and they would carefully irrigate the whole 26 300 ha. Through cooperation and careful management, they achieved a better than average harvest, worth some US$20 million to the country as a whole (Uphoff, 1999). ■

→ *Source:* Uphoff (1999); Wijayaratna and Uphoff (1997)

United States of America: clean drinking-water from agricultural watersheds in New York State

The state of New York gives a good example of the relative costs of restoration against the costs of preventing the damage to natural capital in the first place. New York City gets 90 percent of its drinking water from the 512 000 hectare Catskill-Delaware watershed complex, which yields 5.48 billion litres of water per day for its 9 million users. In the late 1980s, the city was faced with having to construct a filtration facility to meet new drinking water standards, the cost of which would be US$5–8 billion, plus another US$200–500 million in annual operating costs. Estimates at the time indicated that 40 percent of the cropland in the watershed complex would also have to be taken out of farming so as to reduce run-off of eroded soil, pesticides, nutrients and bacterial and protozoan pathogens.

Instead, it decided on a collaborative approach with farmers. It funded a Watershed Agricultural Council, a partnership of farmers, government and private organizations, that sought voluntary upstream solutions to the drinking water problem. The aim was both to protect the city's drinking water supply and to sustain the rural economy. It works on whole farm planning with each farm, tailoring solutions to local conditions to maximize the reduction in off-site or external costs. The initial target was 85 percent of the total 550 farmers; otherwise the city reserved the right to enforce regulations on farmers. The first two phases of the programme leading to the 85 percent target will have cost some US$100 million. This represents a small fraction of the cost of a filtration plant. Not only does the city and its taxpayers benefit, but so do the communities in the watershed and their local natural capital. ■

→ *Source:* Pretty (1998). The Living Land

Calculations of externalities (side-effects) of agriculture

Externalities in Europe and North America

Several studies have recently sought to cost the negative externalities of modern agriculture in Germany, Netherlands, United Kingdom and the United States of America, or to illustrate the losses in ecosystem services with the modernization of agriculture in Sweden. The data, however, are not wholly comparable in their original form as different frameworks and methods of assessment have been used. Methodological concerns have also been raised about some studies.

Some have noted that several effects could not be assessed in monetary terms, whilst others have appeared to be more arbitrary (e.g. the US$2 billion cost of bird deaths in the US is arrived at by multiplying 67 million losses by US$30 a

bird. A study on Netherlands agriculture was even more arbitrary, as it added an estimate the costs farmers would incur to reach stated policy objectives, and these were based on predicted yield reductions of 10-25 percent arising from neither cheap nor preferable technologies, which led to a large overestimate of environmental damage.

A new framework was recently developed for a University of Essex led study of the United Kingdom agriculture, and is used to present new comparative data on negative externalities in the United Kingdom, United States and Germany (see Table). This uses seven cost categories to assess negative environmental and health costs. Two types of damage cost were estimated for the United Kingdom: i) the treatment or prevention costs (those incurred to clean up the environment and restore human health to comply with legislation or to return these to an undamaged state); and ii) the administration and monitoring costs (those incurred by public authorities and agencies for monitoring environmental, food and health parameters). Only those externalities which gave rise to financial costs were estimated.

This framework includes only external costs, i.e. the costs passed on to the rest of society through the actions of farmers. Additional private costs borne by farmers themselves are not included, such as from increased pest or weed resistance from the overuse of pesticides, or for training in the use, storage and disposal of pesticides. However, there remain unmeasured distributional problems: for example insect outbreaks arising from pesticide overuse can affect all farmers, even those not using pesticides.

Even though the research to date still contains many gaps where costs have yet to be calculated, these studies suggest that the external costs of modern agriculture in 1996 amounted to £49-71 (US$81–117) per hectare of arable and grassland in Germany and the United States, but rising to £208 (US$343) in the United Kingdom. These differences, however, may not be significant, owing to large gaps and uncertainties in the data (without the cost of BSE, for example, the per hectare costs in the United Kingdom come down to £154/ha). It appears that costs per hectare of arable are higher than for livestock; and the external costs associated only with pesticides amount to £2.2–8.6 (US$3.7–14.2) per kg active ingredient used. These are substantial burdens on non-agricultural sectors of economies.

For a variety of reasons, these estimates are likely to be conservative:

- some costs are known to be substantial underestimates (e.g. acute and chronic pesticide poisoning of humans; monitoring costs; eutrophication of reservoirs; restoration of all hedgerow losses);
- some currently cannot be calculated (e.g. dredging to maintain navigable water; flood defenses; marine eutrophication; poisoning of domestic pets);
- the costs of returning the environment or human health to pristine conditions were not calculated;
- treatment and prevention costs may be underestimates of how much people might be willing to pay to see positive externalities created;
- the data do not account for time lags between the cause of a problem and its expression as a cost (i.e. some processes long since stopped may still be causing costs; some current practices may not yet have caused costs);
- this study did not include the externalities arising from transporting food from farms to manufacturers, processors, retailers and finally to consumers.

The annual external costs of modern agriculture in United Kingdom, United States of America and Germany ($ million, adjusted to 1996 prices)

Cost Category	United Kingdom	United States of America	Germany
1. Damage to Natural Capital: Water			
Pesticides in sources of drinking water	187	921	90
Nitrate, phosphate and soil in sources of drinking water	110	1 267	+
Zoonoses (esp. *Cryptosporidium*) in sources of drinking water	36	+	+
Eutrophication, pollution incidents, fish deaths, monitoring costs	26	265	51
2. Damage to Natural Capital: Air			
Emissions of methane, ammonia, nitrous oxide and carbon dioxide	1 733	17 028	1 752
3. Damage to Natural Capital: Soil			
Off-site damage caused by erosion	22		+
flooding, blocked ditches and lost water storage		3 561	
damage to industry, navigation and fisheries		8 978	
Organic matter and carbon dioxide losses from soils	128	+	+
4. Damage to Natural Capital: Biodiversity and Landscape			
Biodiversity/wildlife losses	39	340	6
Hedgerows and drystone wall losses	154	+	+
Bee colony losses and damage to domestic pets	3	237	2
5. Damage to Human Health: Pesticides	12	137	14
6. Damage to Human Health: Nitrate	0	+	+
7. Damage to Human Health: Microorganisms / Disease Agents			
Bacterial and viral outbreaks in food	263	+	+
BSE and new variant CJD	946	+	+
Overuse of antibiotics	+	+	+
Total annual external costs	**3 650**	**32 762**	**1 917**
Total costs per hectare of arable and grassland	**324**	**76**	**111**
Costs per hectare of arable only	**355**	**106**	**259**
Costs per kg of pesticide active ingredient	**13.4**	**3.4**	**6.1**

+ = cost estimates not yet calculated (or available).

→ *Source:* Pretty *et al.* (2001). Policy challenges and priorities for internalizing the externalities of modern agriculture. *Journal of Environmental Planning and Management* 44 (2), 263-283

New carbon sinks in agriculture

Summary of carbon issues in agriculture

Agricultural systems contribute to carbon emissions through:

- the direct use of fossil fuels in farm operations;
- the indirect use of embodied energy in inputs that are energy-intensive to manufacture;
- the cultivation of soils resulting in the loss of organic matter.

On the other hand, farming offsets such losses when it accumulates organic matter in the soil, or when above-ground woody biomass acts either as a permanent sink or is used as an energy source that substitutes for fossil fuel. Options for reducing carbon emissions from farms include conservation of fuel and reduced energy use; conservation tillage to reduce CO_2 emissions from soils; grass-based grazing systems to reduce methane emissions; composting to reduce manure methane production; substitute fossil fuels by biofuels; adopt low machinery-use; reduce use of inorganic fertilizers; and targeted and slow release fertilizers. Options for increasing carbon sinks on farms include conservation and no-tillage; mixed rotations using cover crops and green manures; minimize summer fallows; apply composts and manures; improve pasture and rangelands through grazing and vegetation management; use perennial rather than annual grasses, as perennials have 60–80 percent of biomass below ground compared with 20 percent for annuals; restoring and protecting wetlands (provided C-sequestration is greater than methane production); converting agricultural land to woodlands; adopt agroforestry; and cultivate crops for biofuels (grasses, coppiced trees). ■

→ *Source:* Pretty and Ball (2001)

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 percent of all Argentinean arable land. ZT has also spread rapidly in Paraguay and southern Brazil over the same period. There are several reasons for this rapid spread:

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

- direct support and promotion by farmers organizations themselves, in particular AAPRESID (Argentinean No Till farmers' organization) – as Roberto Peiretti puts it: "*the adoption of NT in Argentinean 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. ■

Source: Roberto Peiretti (Member of the Board of Directors and Technical Committees of AAPRESID (No-Till Farmers Argentinean Association) and member of the Steering Committee of CAAPAS (American Confederation of Sustainable Agriculture Farmers Association) < sdrob@idi.com.ar >

This publication reports on the progress in developing and developed countries towards sustainable use of land and water in agricultural systems, and assesses the extent to which such projects/initiatives had improved food production. These are a self-selecting set, as we specifically set out to find out what could be achieved with sustainable agriculture, rather than analyse what was being achieved in a typical agricultural project. We rejected cases: i) where there was no obvious sustainable agriculture link; ii) where payments were used to encourage farmer participation (there are doubts that ensuing improvements persist after such incentives); iii) where there was heavy reliance on fossil-fuel derived inputs, or only on their targeted use (this is not to negate these technologies, but to indicate that they were not the focus of this research); iv) where the data provided was too weak or the findings unsubstantiated.

This is the largest known survey of sustainable agriculture in developing countries. There were 45 projects in Latin America, 63 in Asia and 100 in Africa. In these 208 projects/initiatives, some 8.98 million farmers have adopted sustainable agriculture practices and technologies on 28.92 million hectares. As there are some 960 million hectares of land under cultivation (arable and permanent crops) in Africa, Asia and Latin America, sustainable agriculture is present on at least three percent of this land (total arable land comprises some 1 600 million hectares in 1995/97, of which 388 million ha are in industrialised countries, 267 million ha in transition countries, and 960 million ha in developing countries: FAO, 2000).

The largest country representations in the dataset are India (23 projects/initiatives); Uganda (20); Kenya (17); Tanzania (10); China (8); the Philippines (7); Malawi (6); Honduras, Peru, Brazil, Mexico, Burkina Faso and Ethiopia (5); and Bangladesh (4). The projects and initiatives range very widely in scale – from 10 households on 5 hectares in one project in Chile to 200 000 farmers on 10.5 million hectares in southern Brazil. Most of the farmers in the projects surveyed are small farmers. Of farms in the total dataset, 50 percent are in projects with a mean area per farmer of less than one ha, and 90 percent of less than or equal to 2 hectares. There are some 8.64 million small farmers practising sustainable farming on 8.33 million hectares, and 349 000 larger farmers in Argentina, Brazil and Paraguay farming with zero-tillage methods on 2.59 million hectares. Most of this sustainable agriculture has emerged in the past decade. Using project records, we estimate that the area a decade ago was between 100 000–500 000 hectares.

These cases demonstrate that improvements in food production are occurring through one or more of five different mechanisms:

1. intensification of a single component of farm system (with little change to the rest of the farm) – such as home garden intensification with vegetables and/or tree crops, vegetables on rice bunds, and introduction of fish ponds or a dairy cow;
2. addition of a new productive element to a farm system, such as fish or shrimps in paddy rice, or agroforestry, which provides a boost to total farm food production and/or income, but which do not necessarily affect cereal productivity;
3. better use of natural capital to increase total farm production, especially water (by water harvesting and irrigation scheduling), and land (by reclamation of degraded land), so leading to additional new dryland crops and/or increased supply of additional water for irrigated crops (so increasing cropping intensity);
4. improvements in per hectare yields of staples through introduction of new regenerative elements into farm systems (e.g. legumes, integrated pest management);
5. improvements in per hectare yields through introduction of new and locally-appropriate crop varieties and animal breeds.

Thus a successful sustainable agriculture project may be substantially improving domestic food consumption or increasing local food barters or sales through home gardens or fish in rice fields, or better water management, without necessarily affecting the per hectare yields of cereals. In the dataset, the most common mechanisms were yield improvements with regenerative technologies or new seeds/breeds, occurring in 60 percent of the projects, by 56 percent of the farmers and over 89 percent of the area.

Home garden intensification occurred in 20 percent of projects, but given its small scale only accounted for 0.7 percent of area. Better use of land and water, giving rise to increased cropping intensity, occurred in 14 percent of projects, with 31 percent of farmers and 8 percent of the area. The incorporation of new productive elements into farm systems, mainly fish and shrimps in paddy rice, occurred in 4 percent of projects, and accounted for the smallest proportion of farmers and area.

As mechanisms 4 and 5 were the most common, we analysed these in greater detail. The dataset contains 89 projects (139 entries of crop x projects combinations) with reliable data on per hectare yield changes with mechanisms 4 and 5. These cases illustrate that sustainable agriculture has led to an average 93 percent increase in per hectare food production through mechanisms 4 and 5 above. The relative yield increases are greater at lower yields, indicating greater benefits for poor farmers, and for those missed by the recent decades of modern agricultural development.

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This compendium of recent sustainable development initiatives in the field of agriculture and land management has been developed as a supporting document for the Task Manager's Report on the Land and Agriculture Cluster for Chapters 10, 12 and 14 of Agenda 21. The report draws together 75 cases from over 45 countries, illustrating the many features of improved land management and sustainable agriculture and rural development. These are intended to provide important supporting evidence of the progress in the implementation of the United Nations Conference on Environment and Development (UNCED), Agenda 21, and the need for further upscaling of these cases to address the challenges of poverty, hunger and sustainable development.