iied

International Institute for Environment and Development

Sustainable Agriculture and Rural Livelihoods Programme

Gatekeeper Series no. 87

Making Water Management Everybody's Business: Water Harvesting and Rural Development in India

Anil Agarwal and Sunita Narain

1999

The Gatekeeper Series produced by IIED's Sustainable Agriculture and Rural Livelihoods Programme aims to highlight key topics in the field of sustainable agriculture and resource management. Each paper reviews a selected issue of contemporary importance and draws preliminary conclusions for development that are particularly relevant for policymakers, researchers and planners. References are provided to important sources and background material. The Series is published three times a year – in April, August and December – and is supported by the Swedish International Development Cooperation Agency (Sida).

The views expressed in this paper are those of the author(s), and do not necessarily represent those of the International Institute for Environment and Development (IIED), The Swedish International Development Cooperation Agency (Sida), or any of their partners.

Anil Agarwal is director, and Sunita Narain deputy director, of the Delhi-based Centre for Science and Environment. They have been researching and publishing on environment and development issues for over 20 years. In 1997 they edited their fouth *State of India's Environment Report* entitled *Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems*. The book has provided an impetus to researchers and policy makers to look at the science of the past and to implement it in finding answers for the emerging water crisis in developing countries. Agarwal and Narain continue to advocate, through their writings, the need for participatory democracy for environmental management. They can both be contacted at: The Centre for Science and Environment, 41 Tuglakabad Institutional Area, New Delhi 110 061, India. Tel: +91-11-6995778, +91-11-6981110; Fax: +91-11-6980870; Email: anil@cseindia.org and sunita@cseindia.org

1999

Executive Summary

As the 21st century approaches, a growing number of countries are facing a crisis in ensuring their expanding populations receive adequate, clean water. In India, nearly 44 million people are affected by water quality problems, and availability of water is also a huge problem in many areas, with the per capita availability of water in 2001 expected to be half its 1947 level.

This water crisis is occurring in India despite it being one of the wettest countries in the world. The country currently uses only a small part of its water endowment - there is still huge potential for it to meet its water needs through developing water harvesting systems. With about five to 10 per cent of India's land area set aside for rainwater collection, most of India's irrigation and household water needs could be met.

Yet India has a rich tradition in rainwater harvesting, and many examples of this are provided in the paper. But this tradition, and the knowledge and management systems which accompanied it, has been undermined by two recent changes, largely brought about by colonial attitudes to water management and administration:

1. The state has become the major provider of water, replacing communities and households as the primary units for provision and management of water.

2. There has been increasing emphasis on the use of surface and groundwater, while the earlier reliance on rainwater and floodwater has declined, even though rainwater and floodwater are available in much greater abundance.

However, a number of recent initiatives, both community and government-driven, demonstrate that reviving rainwater harvesting systems can dramatically restore ecosystems and contribute to rural development. But the success of these cases does not just depend on the development of rainwater harvesting structures; the entire exercise must be underpinned by community-based decision-making systems and institutions, and enabling legal and financial measures which promote community action.

The only way this objective can be achieved is by deepening systems of participatory democracy and expanding people's participation at the village-level as much as possible. Every settlement must have a clearly and legally defined environment to protect, care for and use, and an open forum in which all can get together to discuss their problems and find common solutions. By strengthening and emphasising the importance of open forums, common solutions and common natural resources, the developing world can make a determined bid to revive the dying community spirit and to rebuild its devastated environment.

MAKING WATER MANAGEMENT EVERYBODY'S BUSINESS: WATER HARVESTING AND RURAL DEVELOPMENT IN INDIA

Anil Agarwal and Sunita Narain

The Water Crisis

At the dawn of the 21st century, numerous countries, including India, are facing a growing water crisis. About 80 countries comprising 40 percent of world's population already suffer from serious water shortages (Nigam *et al.*, 1997). In India, this crisis is already visible, contributing to enormous social, political and environmental costs that are affecting the economy and quality of life. Nearly 44 million people in India are affected by water quality problems either due to pollution, the prevalence of fluoride, arsenic and iron deposits in groundwater, or due to ingress of sea-water into groundwater aquifers (Nigam *et al.*, 1997). Millions do not have enough water, particularly during summer months, and women and girls have to walk long distances to fetch water. In the search for water, people are going deeper into the ground, lowering the groundwater table and leaving wells dry. The per capita availability of water for India in 2001 is expected to be half its 1947 level (Nigam *et al.*, 1997).

Poor sanitation and unsafe drinking water account for a substantial part of the disease burden in India, contributing to diarrhoea, dysentery, typhoid, worms, jaundice and cholera. The World Bank has estimated that in 1993, the economic cost of the deaths and illness caused by water and air pollution alone accounted for Rs. 24,000 crore (US $6 billion) - an amount equal to the cost of two Narmada dams every year. Water pollution alone accounted for Rs. 19,950 crore (US $5 billion) (Carter, 1995).

Water is not only vital for human survival but is also the foundation for a sustainable biomass-based economy. Though substantial investments are being made in exploiting river and groundwater resources to support large-scale irrigation systems and urban water supply, these systems have rarely reached out to poor rural people. Large-scale water development systems have also often led to inefficient and inequitable distribution of water resources and forced displacement of the poor. Major institutional, policy and technological initiatives are, therefore, required to ensure the efficient, socially equitable and environmentally sustainable management of water resources.

The Potential for Rainwater Harvesting

India's growing water shortage is occurring despite it being one of the wettest countries in the world. It receives 400 million hectare-metres (mham) of precipitation annually,

primarily as rain supplemented by some 20 mham of river flows from neighbouring countries. But it uses only a small part of its water endowment.

By the year 2025, India is expected to use 105 mham annually; up from 38 mham annually in 1974 (Nag and Kathpalia, 1975). If all this water use was to be met from rivers and groundwater systems, riverine ecosystems and groundwater resources would come under extreme stress, already occurring across the country. River flows and groundwater add up to 247 million hectare-metres, of which a substantial amount must flow out to neighbouring countries and to the sea (Nag and Kathpalia, 1975). But India still has an enormous amount — theoretically as much as 173 million hectare-metres — that could be captured as rain or as run-off from small catchments in and near villages or towns. Currently it is lost through evaporation and so on. Therefore the theoretical potential of water harvesting for meeting household needs is enormous. Rain captured from 1-2 per cent of India's land could provide India's population of 950 million with as much as 100 litres of water per person per day (Agarwal, 1998a). There is no village in India which could not meet its drinking water needs through rainwater harvesting. Even in an arid area with an annual rainfall level of only 100 mm, one hectare of land could theoretically capture as much as one million litres of water (see below). As there is a synergy between population density and rainfall levels, less land is required in more densely populated areas to capture the same amount of rainwater. And in such areas there are usually more non-porous surfaces like roof-tops which have improved runoff efficiency.

Water harvesting means capturing the rain where it falls, or capturing the run-off in one's own village or town. There are a variety of ways of harvesting water, including:

- Capturing runoff from rooftops
- Capturing runoff from local catchments
- Capturing seasonal floodwaters from local streams
- Conserving water through watershed management

Water harvesting can bring many benefits:

- Apart from increasing water availability, local water harvesting systems developed by local communities and households can reduce the pressure on the state to provide all the financial resources needed for water supply. As governments in developing countries are often short of funds, this approach will greatly reduce constraints posed by financial considerations.
- Involving people will also give them greater ownership over water projects and will go a long way towards reducing misuse of government funds.
- Moreover, when communities and households develop their own water supply systems, they are more likely to look after them — the spectre of unrepaired, broken down systems and wasted funds will haunt governments less. Water will also be used more efficiently instead of being squandered.

In human terms, rainwater harvesting therefore means making water everybody's business. Every household becomes involved both in the provision of water and in the protection of water sources. It means re-establishing the relationship between people and their environment and turning water into a precious commodity, rather than something to be taken for granted. It means the empowerment of urban and rural communities to manage their own affairs, with the state playing a critical supportive role and civil society playing a vital role in encouraging equity and sustainability of water use.

Therefore, there is eminent sense, ecological[1], financial and political, in promoting community and household-based water harvesting systems. Water harvesting can not only meet people's basic water needs but also improve the food and livelihood security of the rural poor (Anon, 1998a and 1998b).

Diverse Technologies: A Treasure Trove

Water harvesting and integrated land-water management are not new to India or to many other parts of the developing world (Box 1). The art and science of 'collecting water where it falls' is an ancient but dying wisdom which needs to be revived to meet modern freshwater needs adequately, equitably and sustainably, and modernised with inputs from science and technology (Agarwal and Narain, 1997).

Box 1. A history of harvesting

India has had a tradition of water harvesting which is more than two millennia old. Evidence of this tradition can be found in ancient texts, inscriptions, local traditions and archaeological remains. There is some evidence of the existence of advanced water harvesting systems even from pre-historic times. Hindu texts like the *Puranas*, *Mahabharata* and *Ramayana* and various Vedic, Buddhist and Jain works contain several references to canals, tanks, embankments and wells (Pande, 1997).

Of particular historical significance is recent evidence from Dholavira, a major site of the Indus Valley civilisation, dating back to the third millennium BC. The site is located in the Great Rann of Kutch, and was one among the five largest Harappan cities excavated so far. Discovered in the 1960s, Dholavira lies in an arid area that gets an average annual rainfall of 260 mm. There are no perennial sources of water in the form of lakes or rivers. Subterranean water is, by and large, brackish and saline. The inhabitants of Dholavira, therefore, created several reservoirs to collect the monsoon runoff flowing down the flanking streams of the Manhar and Mansar. Stone bunds were raised across them at suitable points to divert the flow of water into a series of reservoirs that were dug out in the sloping areas between the inner and outer walls of the Harappan city. Likewise, a network of drains criss-crossing the citadel was also laid out to collect rainwater. Rainwater harvesting was the way of life.

1. There is little information available on the ecological impacts of rainwater harvesting on groundwater and river flows. However, as rainwater harvesting improves groundwater recharge it should in fact, improve the perennial flow of rivers. It may, however have an impact on the seasonal flows – however as this would minimise flows during monsoons it may help to reduce the risk of floods.

India's traditional water harvesting structures demonstrate people's ingenuity at its best. Using unique modes and basic engineering skills, people living in ecosystems across the country have developed a wide array of techniques for satisfying their thirst.

Hill areas: diverting streams

Traditionally, wherever there were streams, especially in the hill and mountain regions of India, people diverted water using simple engineering structures into artificial channels that would take it to the fields (Agarwal and Narain, 1997). The indigenous people of north-eastern India continue to build bamboo pipelines to carry water from natural springs to a convenient point where it can be used for drinking. This art has been raised to a sublime level by the people of southern Meghalaya, near the border of Bangladesh, who use intricate networks of bamboo pipelines to deliver water to betel leaf plantations in rocky areas where it is impossible to build channels. The entire system literally works like a modern drip irrigation network that delivers measured quantities of water straight to the roots of the plants. Some 18-20 litres of water enter the bamboo irrigation systems every minute and after getting transported over several hundred metres, finally get reduced to 20-80 drops per minute at the site of the plant (Agarwal and Narain, 1997).

Western and central India: dams to capture runoff

In several parts of India, people have built dams across seasonal channels to capture runoff. But these structures, unlike normal dams, are used to moisten the soil so that the post-monsoon crop would be assured of the rich soil of the tank bed itself. In dry areas of Rajasthan, people have traditionally practised conjunctive use of surface water and groundwater. They often built structures like wells and stepwells (wells with a flight of stairs leading down to the water, below tanks and other types of water storage structures). Thus, when the tank water dried up, people could at least harvest clean groundwater to meet their drinking water needs. Rajasthan also has a tradition of using rooftops as a catchment area to collect rainwater.

In areas where land is not a limiting factor, people have even developed customised rainwater harvesting structures called *kundis*. These are artificial wells which store runoff from an artificially prepared catchment surrounding them so that rainwater falling on the catchment rapidly runs into the well and gets stored. Their potential can be understood by the following fact: If an area receives only 100 mm of rainfall — which would make it an extremely arid environment — this rain harvested over one hectare of land would provide one million litres of water a year. As a family of five would not need more than 10-15 l a day for drinking and cooking — or 3,650-5,475 l a year — 180-270 families could meet their most critical water needs by building a one-hectare *kundi* (Agarwal, 1998a).

South India: building a culture of tanks

In the southern state of Tamil Nadu, a big stream is often diverted to feed a chain of 25-30 tanks in sequence. As this chain of tanks (called 'system tanks') is served by a stream collecting water over a large catchment, it is traditionally considered much more

desirable than a tank with a single, small catchment. The Palar anicut (dam) system, for example, supplies water to 317 tanks, irrigating about 32,000 ha in North Arcot and Chengalpattu districts. The profusion of tanks in Ramnathapuram district of the state can even be seen from a satellite.

Decline Of Water Harvesting Systems

So why have these seemingly efficient rainwater harvesting systems declined? To answer this question we need to look briefly to history. Two major changes have emerged worldwide in water management since the 19th century:

1. The state has become the major provider of water replacing communities and households as the primary units for provision and management of water.

2. There has been growing reliance on the use of surface and groundwater, while the earlier reliance on rainwater and floodwater has declined, even though rainwater and floodwater are available in much greater abundance than river water or groundwater.

The changing role of the state

When the British arrived in India they found it to be a land of 'village republics'. *"The 'village', to an extent, had all the semblance of the State; it controlled revenue and exercised authority within its sphere... The basic element of this 'village republic' was the authority it wielded, the resources it controlled, and dispensed, and the manner of such resource utilisation... Indian society and polity had basically been organised according to non-centralist concepts... That the annual exchequer receipts of Mughal emperor Jahangir did not amount to more than five per cent of the computed revenue of his empire... is symptomatic of the concepts and arrangements which governed Indian polity.... there is voluminous data scattered in the British records themselves which confirm the view, that in terms of the basic expenses, both education and medical care, the expenses of the local police, and the maintenance of irrigation facilities, had primary claims on revenue..."* (Dharampal. 1983.)

British rule, unfortunately, laid this enormous heritage to waste. In their desire to rule, administer and maximise their revenues from this rich land, the British steadily impoverished the rural communities, leading to the destruction of their resource management systems, including the water management structures that had emerged over the centuries.

By about 1800, a very large percentage of these revenue assignments had been altogether dispossessed, reducing their beneficiaries to penury. Most of the remaining had their assignments greatly reduced so that they could no longer perform the educational, water management or other functions that they were expected to undertake. With the destruction of the indigenous financial system, community property slowly became nobody's property.

Furthermore, what the colonial rulers could not own or earn money from, they neglected. As Arthur Cotton, the pioneer of modern irrigation in India, himself noted in 1874 about local water harvesting systems: *"There are a multitude of old native works in various parts of India... These are noble works, and show both boldness and engineering talent. They have stood for hundreds of years. When I first arrived in India, the contempt with which the natives justly spoke of us on account of this neglect of material improvements was very striking; they used to say we were a kind of civilised savages, wonderfully expert about fighting but so inferior to their great men that we would not even keep in repair the works they had constructed, much less even imitate them in extending the system."* (Dutt, 1900).

The British tried to take remedial measures when they realised their mistake, but they failed to comprehend the strength of the indigenous system (Box 2). Firstly, they created irrigation and public works bureaucracies which were supposed to own and manage the neglected water harvesting systems. When these technocracies failed to revive these systems, the British authorities in Madras presidency, in the mistaken belief that local communities would undertake voluntary labour to maintain the tanks as a tradition, enacted the notorious *Madras Compulsory Labour Act* of 1858. This legislation 'forced' villagers to give compulsory labour for desilting tanks and led to considerable resentment in the region. The traditional system in which villagers contributed voluntary labour had died with the death of local ownership of the resource (Vani *et al.*, 1997).

Box 2. Misinterpreting the Landscape

With agricultural production declining rapidly in once prosperous Bengal, the British government invited William Willcocks, a British irrigation expert, to advise it on irrigation development. In a series of lectures delivered in Calcutta in the 1920s, Willcocks stunned everyone by arguing that the absolute best that the government could do was to revive the ancient flood irrigation system of the region (Willcocks, 1930).

When Willcocks tried to plan a system of irrigation canals for the Bengal countryside, he was astonished to find that every 'dead river' on the map sheltered an appropriate place for a canal. To his discerning eye, the parallel alignments of the main canals, maintained over long distances, contrasted sharply with what he called *"the tangled meaningless mass of waterways... where we have nature's undirected handiwork."* He concluded that during floods, the embankments along these canals would have been regularly breached to take the floodwaters to the fields. But the British administrators had mistaken them for flood embankments and considered the regular breaches in them as discreditable efforts of the local people. Therefore, the government did not do anything to desilt these canals and maintain them. Even worse, wherever possible, they constructed solid embankments to prevent wholesale breaches.

The resulting destruction of the overflow irrigation system of Bengal steadily led to a decline in agricultural production, increase in malaria and the famous famines. The region, which never revived the wisdom of its ancestors, remains the poorest in the world.

Declining Emphasis on Rainwater and Floodwater

With the progress of British rule, there was also a gradual shift in emphasis from minor irrigation works like tanks, wells, *bandharas* (dams) and small river channels to large dams and canals commanding extensive areas.

This emphasis was perpetuated through the education system. The British educated an entire class of Indians which no longer appreciated or understood India. They were so successful that when India became independent, the leaders of modern India also turned their backs on the traditional systems and invested almost exclusively in mega-irrigation projects and mega-bureaucracies to manage its water systems. Over time, there has also been a downfall in community self-management as bureaucratic intervention in village affairs has been steadily encouraged by India's political leaders.

Technological changes like the introduction of tubewells mean that richer farmers in the command area of a tank, who can install these tubewells, no longer have an interest in cooperating with the rest of the community in managing the tanks. Many central and southern Indian cities like Hyderabad, Chennai (Madras) and Bangalore grew up around traditional water harvesting systems. But in these urban areas too, these systems have either disappeared because of pressure from real estate lobbies or have become heavily polluted. Today, traditional water harvesting systems are only important in remote areas where the reach of water bureaucracies remains weak, as in many Himalayan states.

The Way Ahead: Learning From Experience

During the 1980s several successful community-based resource management experiences emerged as a response to the crisis in water management. A few examples are described below, and provide valuable lessons about the policies needed for the transformation from ecological poverty to sustainable economic wealth. The cases described are especially important because they are now several years old and have reached an advanced level of ecological succession and associated economic impacts.

Sukhomajri Village

Sukhomajri, located near the city of Chandigarh, is the first village in India to have income tax levied on the income it earns from the ecological regeneration of its degraded watershed. In 1979 when the nation was facing a severe drought, the villagers built small tanks to capture rainwater and agreed to protect their watershed in order to ensure that their tanks did not get silted up (Agarwal and Narain, 1980). The main incentive for the villagers to protect their watershed came because of an assurance from the forest department that they would have the right to the use of the forest land. The villagers argued that as they were protecting the watershed, they should get the benefits from the increased biomass production. The state forest department agreed to give the grass rights to the village as long as the villagers paid the forest department a royalty

equivalent to the average income earned by the department before the villagers started protecting the watershed.

The combination of public, private and community investments and the participatory efforts of the villagers has produced, according to one cost benefit analysis, a rate of return of the order of 19 per cent (Chopra *et al.*, 1990). The tanks have helped to increase crop production nearly threefold and the protection of the forest area has greatly increased grass and tree fodder availability. This, in turn, has increased milk production. With growing prosperity, Sukhomajri's economy has undergone a change. *"Who could imagine that televisions, tractors and bicycles could be had for mere grass and water?"* asks a villager. One of the most impressive savings resulting from the project is in the cost of desilting the Sukhna lake which supplies water to the downstream city of Chandigarh. The inflow of sediment has come down by over 90 per cent. This saves the government Rs. 7.65 million ($0.2 million) each year in dredging and other costs (Chopra *et al.*, 1990).

Ralegan Siddhi Village

Ralegan Siddhi is a village in a drought-prone area of Maharashtra where the annual rainfall ranges from only 450 mm to 650mm and where the villagers were once not even assured one regular crop (Mahapatra, 1997). In 1975, the village was poverty stricken, with less than one acre of irrigated land per family (Hazare, 1997). Krishna Bhaurao Hazare, a retired driver from the Indian army, began constructing storage ponds, reservoirs and gully plugs. Due to the steady percolation of water, the groundwater table began to rise. Simultaneously, government social forestry schemes were used to plant 300,000-400,000 trees in and around the village (Chopra and Rao, 1996). Because of the increased availability of irrigation water, land that was lying fallow came under cultivation and the total area under farming increased from 630 hectares to 950 hectares (Hazare, nd). The average yields of millets, sorghum and onion increased substantially.

Every effort was made in the village to ensure equitable access to the resources generated. Water is distributed equitably. Only low water-consuming crops were allowed (Hazare, pers. comm.). Water conservation efforts resulted in increased availability of groundwater that in turn has facilitated the development of community wells. Water from these wells, supplied at a moderate price, has enabled farmers to grow two to three crops a year including fruits and crops, some of which are exported all the way to Dubai (Mahapatra, 1997).

Today not a single inhabitant of the village depends on drought relief. Incomes have increased substantially. By Indian standards, Ralegan Siddhi is a rich village now. Over a quarter of the households earn nearly half a million rupees a year, and a branch of a major bank has opened in the village. Ralegan Siddhi's income distribution is also much less skewed than that of rural Maharashtra (Rao and Natarajan, 1996).

An impressive system of decision making has been created in the village. Some 14 committees operate to ensure people's participation in all decision making. A participatory democratic institution called the *Gram Sabha* was created to take community decisions and to involve every villager in the development process and exert social pressure wherever required. In other words, Ralegan has given greater importance to participatory democracy than to representative democracy.

Bringing a dead river back to life

Rainwater harvesting has brought the river Arvari in dry and drought-prone Rajasthan back to life (Mahapatra, 1999a). The river flows through a drought stricken region – villagers living on the margins of survival are desperately poor and find sustenance by migrating to cities for work. According to historical records of the region, the river Arvari used to provide groundwater recharge to wells in the area. But nobody can remember seeing it flow except during the short monsoon period. The river – in its 45 km journey to its confluence in the reservoir of a dam on the river Sainthal – flows through 70 odd villages. Its source lies in the degraded hills near the village of Bhaonta-Koylala.

In 1986, working with a local NGO, the Tarun Bharat Sangh (TBS), the villagers of Bhaonta-Koylala built a rainwater harvesting structure locally known as *johad* to trap the rainwater and to use it to recharge the groundwater. Since then over 200 water harvesting structures have been built in the 70 villages in the catchment of Arvari. These small dams have helped to recharge the river. In 1990 it flowed till October. In 1991, till January next year. In 1992, till February next year. In 1993, till March next year. From 1994 it flowed till April and in 1995 the flow did not cease. It has been perennial ever since.

But with the water came the bureaucracy. In 1996 the villagers of Hamirpura living along the Arvari were told that a contractor had been given a licence by the state government to start fishing in the river. Under law the river is the property of the government and now that it had water, it was ready to take 'control' of its resource. But the villagers demanded a say in its management. Working with TBS, in January 1999 they formed a River Parliament, locally known as the *Arvari Sansad* – an association of all the villages along the river course. The meeting that declared the formation of the parliament adopted a constitution to manage the river. If it succeeds this 'people's river parliament' will show the way ahead to a number of communities (Mahapatra, 1999b).

Jhabua District, Madhya Pradesh

Transformation of rural ecosystems with people's participation, such as the cases described above, has remained isolated and scattered, and usually led by remarkable NGO leaders. Government efforts in afforestation and watershed management have

rarely been able to replicate these successes. In most cases, the problem has been that the devolution of power to local communities has been half-hearted and inadequate. People's participation has remained largely stuck in the 'you participate in my programme' mode.

In Madhya Pradesh, however, the government's watershed management programme (the Rajiv Gandhi Watershed Development Mission) has become an outstanding example of government intervention promoting public participation in environmental management. The state-wide programme was initiated by the chief minister Digvijay Singh, after he was inspired by the work of Krishna Bhaurao Hazare in his village Ralegan Siddhi. The programme is integrated and participatory in its approach (Agarwal, 1998). Today, trees are coming up in a district which in the mid-1980s looked like a moonscape. Wells are literally overflowing with water in a place that was described as chronically drought-prone (Agarwal and Mahapatra, 1999).

The programme created several tiers of institutions:, at the state level, for policy coordination; at the district and milli-watershed level[2], for implementation and coordination; and at the village level to ensure that all villagers acquire an interest in the effort. For example, 1,748 women's groups, with 25,506 participants, were created in 374 villages of Jhabua.

But most importantly, serious efforts have been made to give local communities powers over decision making and control over resources. For instance, the villagers play an active role in managing the funds meant for the watershed programme. Nearly 80 per cent of the funds for the programme are put in a bank account managed by the Watershed Development Committees made up of village people. The Watershed Development Committee tries to bring together all the important interest groups in the village and thus replicates the concept of the *gram sabha*.

These case studies show clearly that ecorestoration is possible even in highly degraded lands and that this ecorestoration can regenerate the local rural economy and thus help in poverty alleviation in a sustainable and cost-effective manner (Agarwal and Narain, 1999). In other words, helping the people to help themselves by improving their local natural resource base is a viable and effective strategy for poverty alleviation. The key to this ecorestoration lies in good management and use of the local rainwater, but the entire exercise must be underpinned by community-based decision-making systems and institutions, and enabling legal and financial measures which promote community action.

However, these examples remain scattered because the governance system needed to foster people's control over natural resources does not exist. The locally-led examples came into existence despite the system and not because of the system. It takes enor-

2. A milli-watershed covers 5,000-10,000 hectares and consists of several micro-watersheds of 500-1,000 hectares.

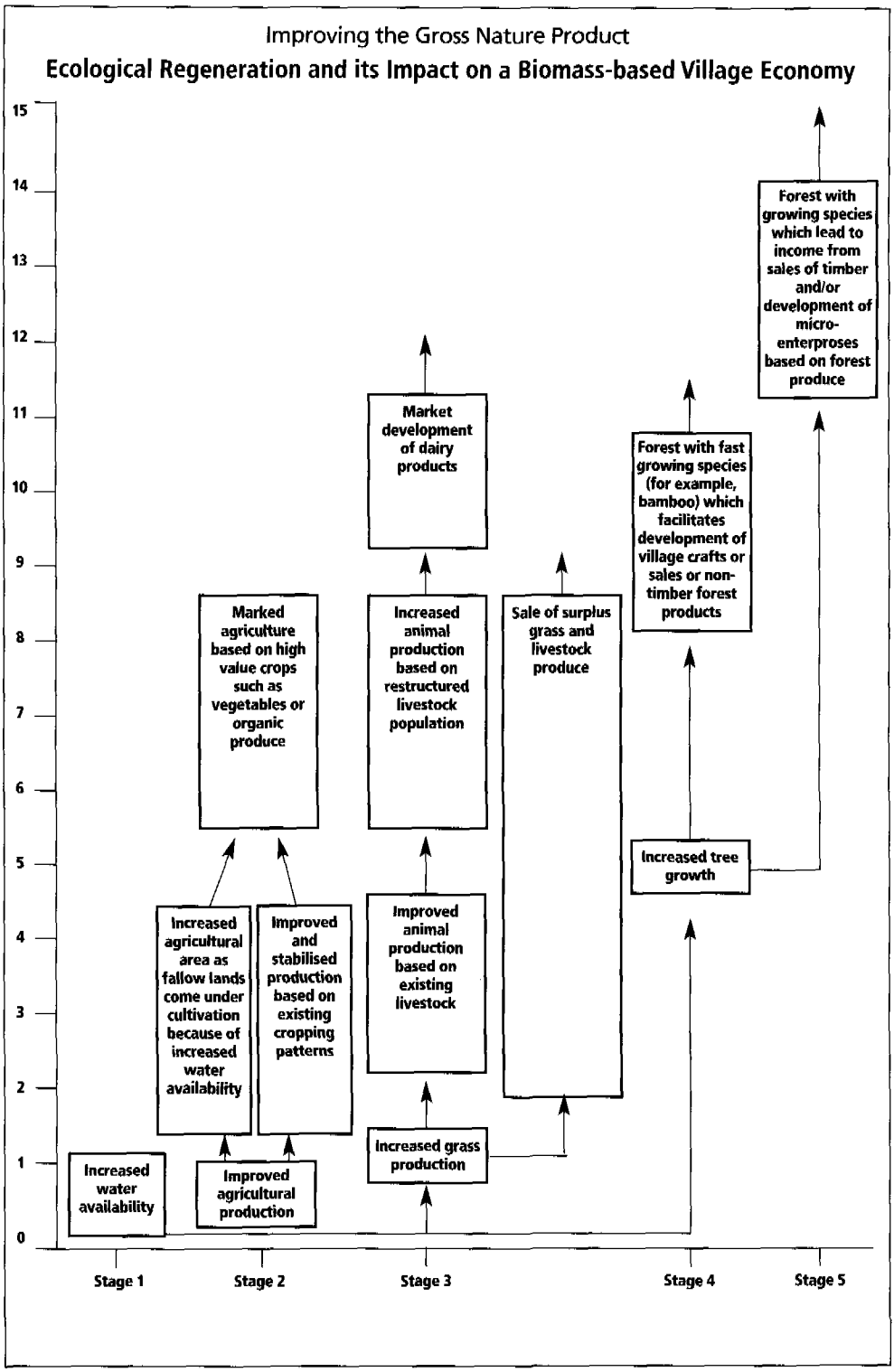
mous perseverance from an individual to bring change at the micro level especially if the governance system does not empower local communities to improve and care for their resource base. But now the Madhya Pradesh government has shown that the state can replicate these community-based efforts if there is adequate political will and pressure on the technical and administrative bureaucracy to deliver. The transformation of Jhabua is a fine example of the results we can expect when a government seriously starts working with the people.

Conclusions

The potential of water harvesting is enormous. With about five to 10 per cent of India's land area set aside for rainwater collection, most of India's irrigation and household water needs could be met. Furthermore, as the cases above illustrate, improved water conservation provides the foundation for a multitude of other improvements (Figure 1), beginning with increased quantity and productivity of croplands because of increased water conservation and, hence, availability of irrigated water, and leading on to increased grass production from the local grasslands and slowly increased production of fodder and timber resources from the tree and forest lands.

But for water harvesting to support sustainable rural development, there will need to be a change in the governance of water systems (Box 3). A decentralised system of water management is required, in turn demanding a community-based system of natural resource management.

The only way this objective can be achieved is by deepening systems of participatory democracy and expanding people's participation at the village-level as much as possible. Every settlement must have a clearly and legally defined environment to protect, care for and use, and an open forum in which all can get together to discuss their problems and find common solutions. By strengthening and emphasising the importance of open forums, common solutions and common natural resources, the developing world can make a determined bid to revive the dying community spirit and to rebuild its devastated environment.


Improving the Gross Nature Product
Ecological Regeneration and its Impact on a Biomass-based Village Economy
15
14
13
12
11
10
9
8
7
6
5
4
3
2
1
0
Forest with growing species which lead to income from sales of timber and/or development of micro-enterproses based on forest produce
Market development of dairy products
Forest with fast growing species (for example, bamboo) which facilitates development of village crafts or sales or non-timber forest products
Marked agriculture based on high value crops such as vegetables or organic produce
Increased animal production based on restructured livestock population
Sale of surplus grass and livestock produce
Increased tree growth
Increased agricultural area as fallow lands come under cultivation because of increased water availability
Improved and stabilised production based on existing cropping patterns
Improved animal production based on existing livestock
Increased grass production
Increased water availability
Improved agricultural production
Stage 1
Stage 2
Stage 3
Stage 4
Stage 5

Box 3. Steps Towards a Community-based System of Natural Resource Management

• *Maintain water as a community resource.* Water as a common property resource is the crucial link for improving the productivity of private croplands. It is vital to maintain the use of local water as a community resource and not to allow water distribution to follow the inequity in land holdings.

• *Adopt an integrated approach to village resource development.* Current rural development efforts are extremely fragmented, focusing mostly on agriculture, and often efforts are contradictory and counterproductive. Yet the 'village ecosystem' usually consists of several integrated components: croplands, grazing lands, forest and tree lands, local water bodies, livestock and various energy sources. What happens in one component invariably impacts on the others, and all is maintained in a delicate ecological balance. Thus development must focus on the holistic enrichment of the ecosystem, whereby attempts are made to increase the productivity of all components, from the grazing lands and forest lands to croplands, water systems and animals.

• *Ensure people's participation in the regeneration of village assets.* All new plantations and grasslands have to be protected, but this will only be achieved with the support of the people. Without this support, the survival rates of village assets like check dams and tanks will be extremely poor.

• *Strengthen village institutions to enable people's participation.* Rational use and maintenance of village land and water resources needs discipline. Villagers have to ensure that animals do not graze in their protected commons, the catchments of their local water bodies are conserved and properly used, and the common produce from these lands is equitably distributed within the village. Villagers can only achieve this if there is an effective village-level institution to energise and involve them in controlling and managing their environment. Deepening democracy at the grassroots is a critical determinant for ecological regeneration and local water management. The village-level institution must work with a high order of democracy and transparency in decision-making in order to engender cooperation and discipline within the group members. In India, village-level institutions have worked best when they are built on the Gandhian concept of a *gram sabha,* in other words, the village institution is one which empowers the assembly of all village adults to take decisions.

• *Promote decision-making forums.* Open public forums are more transparent and accountable and promote more confidence in community decision-making than small, elected village councils. Resolution of intra-village conflicts and coordination are invariably easier in open village meetings. Even where inequality is intense, there will be greater chances of obtaining equitable community decisions in open village forums than in those which are closed and secretive.

• *Develop a legal framework that supports local rights to manage resources.* Currently in India the government owns a substantial portion of land and water resources. The result is that village communities are alienated from their management or protection, leading to massive denudation of forests, overexploitation of grazing lands and neglect of local water systems. Laws dealing with natural resources like land, water and forests will have to be changed to give people the right to improve and develop the village natural resource base. The legal framework should clearly be such that people are encouraged to take the initiative to develop their natural resource base and not wait for the government to act.

• *Channel government funds directly to village institutions.* In the present system, various functionaries and agencies of the government control finances for village development. Ultimately, only a small proportion reaches the community and is spent on projects over which it has no control and which are not a local priority.

References

Agarwal, A. 1998. The house that Digvijay Built. *Down to Earth,* December 31. Society for Environmental Communications, New Delhi.

Agarwal, Anil 1998a. *Rainwater harvesting in a new age: when modern groundwater and river exploitation has reached its limits,* paper presented at the Stockholm Water Symposium, August 10-13, Stockholm International Water Institute, Paper 2, Sweden

Agarwal, A. and Mahapatra, R. 1999. Madhya Pradesh: regaining paradise. In: Agarwal, A., Narain, S. and Sen, S. (eds.) 1999. *State of India's Environment-1999: Citizens' Fifth Report.* Centre for Science and Environment, New Delhi.

Agarwal, A. and Narain, S. 1999. *Community and Household Water Management, the Key to Environmental Regeneration and Poverty Alleviation.* Mimeo. Centre for Science and Environment, New Delhi.

Agarwal, A. and Narain, S. (eds.). 1997. *Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems, State of India's Environment: A Citizens' Report,* Centre for Science and Environment, New Delhi.

Agarwal, A. and Narain, S. 1980. *Strategies for the Involvement of the Landless and Women in Afforestation: Five case studies from India.* Mimeo. World Employment Programme, International Labour Office, Geneva.

Anon. 1998a. *Traditions, Technologies, Policies and Social Mobilisation.* CSE Briefing Paper: Potential of Water Harvesting, Centre for Science and Environment, New Delhi.

Anon. 1998b. *Draft Recommendations of the CSE Conference on Water Harvesting - Technologies, Policies and Social Mobilisation,* October 3-5, New Delhi. Centre for Science and Environment, New Delhi.

Carter, B. 1995. *Valuing Environmental Costs in India: The Economy-wide Impact of Environmental Degradation.* Mimeo. Asia Environment Division, World Bank, Washington D.C.

Chopra, K. and Subba Rao, DV. 1996. *Economic Evaluation of Soil and Water Conservation Programmes in Watersheds.* Institute of Economic Growth, Delhi.

Chopra, K., Kadekodi, G. and Murthy, MN. 1990. *Participatory Development: People and Common Property Resources.* Sage Publications, New Delhi.

Dharampal. 1983. *The Beautiful Tree. Indigenous Indian education in the eighteenth century.* Biblia Impex Private Ltd, New Delhi.

Dutt, R.C. 1900. *Famines and Land Assessment in India.* Kegan Paul, Trench Trubner and Co Ltd, London.

Hazare, A. 1997. *Ralegan Siddhi: A Veritable Transformation.* Ralegan Siddhi Pariwar, Ralegan Siddhi.

Hazare, A. No date. *Microwatershed Development.* Unpublished mimeo.

Mahapatra, R. 1999a. Waters of life. *Down To Earth*, March 15. Society for Environmental Communication, New Delhi.

Mahapatra 1999b. The Arvari, coming back to life. *Down To Earth*, March 15. Society for Environmental Communication, New Delhi.

Mahapatra, R. 1997. *Field Report on Adarsh Gaon Yojana.* Mimeo. Centre for Science and Environment, New Delhi.

Nag, BN. and Kathpalia, GN. 1975. Water and human needs. Paper presented at the *Second World Congress on Water Resources*, Vol.2, CBIP, New Delhi.

Nigam, A., Gujja, B., Bandyopadhyay, J. and Talbot, R. 1997. *Fresh Water for India's Children and Nature: A draft report based on local level studies.* WWF/UNICEF, India.

Pande, BM. 1997. A multi-millennial mission. Cited in Agarwal, A. and Narain, S. (eds.). 1997. *Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems, State of India's Environment: A Citizens' Report*, Centre for Science and Environment, New Delhi.

Rao, SL. and Natarajan, I. 1996. *Indian Market Demographics: The Consumer Classes,* Global Business Press/National Council of Applied Economic Research, New Delhi.

Vani, MS 1997 in Agarwal, A. and Narain, S. (eds.). 1997. *Dying Wisdom: Rise, Fall and Potential of India's Traditional Water Harvesting Systems, State of India's Environment: A Citizens' Report*, Centre for Science and Environment, New Delhi.

Willcocks, W. 1930. *Lectures on the Ancient System of Irrigation in Bengal and its Application to Modern Problems,* Calcutta University Readership Lectures, University of Calcutta.

Gatekeeper Series

1. Pesticide Hazards in the Third World: New Evidence from the Philippines. 1987. J.A. McCracken and G.R. Conway.

2. Cash Crops, Food Crops and Agricultural Sustainability. 1987. E.B. Barbier.

3. Trees as Savings and Security for the Rural Poor. 1992. Robert Chambers, Czech Conroy and Melissa Leach. (1st edition, 1988)

4-12 Out of Print

13. Crop-Livestock Interactions for Sustainable Agriculture. 1989. Wolfgang Bayer and Ann Waters-Bayer.

14. Perspectives in Soil Erosion in Africa: Whose Problem? 1989. M. Fones-Sondell.

15-16. Out of Print

17. Development Assistance and the Environment: Translating Intentions into Practice. 1989. Marianne Wenning.

18. Energy for Livelihoods: Putting People Back into Africa's Woodfuel Crisis. 1989. Robin Mearns and Gerald Leach.

19. Crop Variety Mixtures in Marginal Environments. 1990. Janice Jiggins.

20. Displaced Pastoralists and Transferred Wheat Technology in Tanzania. 1990. Charles Lane and Jules N. Pretty.

21. Teaching Threatens Sustainable Agriculture. 1990. Raymond I. Ison.

22. Microenvironments Unobserved. 1990. Robert Chambers.

23. Low Input Soil Restoration in Honduras: the Cantarranas Farmer-to-Farmer Extension Programme. 1990. Roland Bunch.

24. Rural Common Property Resources: A Growing Crisis. 1991. N.S. Jodha.

25. Participatory Education and Grassroots Development: The Case of Rural Appalachia. 1991. John Gaventa and Helen Lewis.

26. Farmer Organisations in Ecuador: Contributions to Farmer First Research and Development. 1991. A. Bebbington.

27. Indigenous Soil and Water Conservation in Africa. 1991. Reij. C.

28. Tree Products in Agroecosystems: Economic and Policy Issues. 1991. J.E.M. Arnold.

29. Designing Integrated Pest Management for Sustainable and Productive Futures. 1991. Michel P. Pimbert.

30. Plants, Genes and People: Improving the Relevance of Plant Breeding. 1991. Angelique Haugerud and Michael P. Collinson.

31. Local Institutions and Participation for Sustainable Development. 1992. Norman Uphoff.

32. The Information Drain: Obstacles to Research in Africa. 1992. Mamman Aminu Ibrahim.

33. Local Agro-Processing with Sustainable Technology: Sunflowerseed Oil in Tanzania. 1992. Eric Hyman.

34. Indigenous Soil and Water Conservation in India's Semi-Arid Tropics. 1992. John Kerr and N.K. Sanghi.

35. Prioritizing Institutional Development: A New Role for NGO Centres for Study and Development. 1992. Alan Fowler.

36. Out of Print

37. Livestock, Nutrient Cycling and Sustainable Agriculture in the West African Sahel. 1993. J.M. Powell and T.O. Williams.

38. O.K., The Data's Lousy, But It's All We've Got (Being a Critique of Conventional Methods. 1993. G. Gill.

39. Homegarden Systems: Agricultural Characteristics and Challenges. 1993. Inge D. Hoogerbrugge and Louise O. Fresco.

40. Opportunities for Expanding Water Harvesting in Sub-Saharan Africa: The Case of the Teras of Kassala. 1993. Johan A. Van Dijk and Mohamed Hassan Ahmed.

41 Out of Print

42. Community First: Landcare in Australia. 1994. Andrew Campbell.

43. From Research to Innovation: Getting the Most from Interaction with NGOs in

Farming Systems Research and Extension. 1994. John Farrington and Anthony Bebbington.

44. Will Farmer Participatory Research Survive in the International Agricultural Research Centres? 1994. Sam Fujisaka.

45. Population Growth and Environmental Recovery: Policy Lessons from Kenya. 1994. Mary Tiffen, Michael Mortimore and Francis Gichuki.

46. Two Steps Back, One Step Forward: Cuba's National Policy for Alternative Agriculture. 1994. Peter Rosset and Medea Benjamin.

47. The Role of Mobility Within the Risk Management Strategies of Pastoralists and Agro-Pastoralists. 1994. Brent Swallow.

48. Participatory Agricultural Extension: Experiences from West Africa. 1995. Tom Osborn.

49. Women and Water Resources: Continued Marginalisation and New Policies. 1995. Francis Cleaver and Diane Elson.

50. New Horizons: The Economic, Social and Environmental Impacts of Participatory Watershed Development. 1995. Fiona Hinchcliffe, Irene Guijt, Jules N. Pretty and Parmesh Shah.

51. Participatory Selection of Beans in Rwanda: Results, Methods and Institutional Issues. 1995. Louise Sperling and Urs Scheidegger.

52. Trees and Trade-offs: A Stakeholder Approach to Natural Resource Management. 1995. Robin Grimble, Man-Kwun Chan, Julia Aglionby and Julian Quan.

53. A Role for Common Property Institutions in Land Redistribution Programmes in South Africa. 1995. Ben Cousins.

54. Linking Women to the Main Canal: Gender and Irrigation Management. 1995. Margreet Zwarteveen.

55. Soil Recuperation in Central America: Sustaining Innovation After Intervention. 1995. Roland Bunch and Gabinò López.

56. Through the Roadblocks: IPM and Central American Smallholders. 1996. Jeffery Bentley and Keith Andrews.

57. The Conditions for Collective Action: Land Tenure and Farmers' Groups in the Rajasthan Canal Project. 1996. Saurabh Sinha.

58. Networking for Sustainable Agriculture: Lessons from Animal Traction Development. 1996. Paul Starkey.

59. Intensification of Agriculture in Semi-Arid Areas: Lessons from the Kano Close-Settled Zone, Nigeria. 1996. Frances Harris.

60. Sustainable Agriculture: Impacts on Food Production and Food Security. 1996. Jules Pretty, John Thompson and Fiona Hinchcliffe.

61. Subsidies in Watershed Development Projects in India: Distortions and Opportunities. 1996. John M. Kerr, N.K. Sanghi and G. Sriramappa.

62. Multi-level Participatory Planning for Water Resources Development in Sri Lanka. 1996. K. Jinapala, Jeffrey D. Brewer, R. Sakthivadivel.

63. Hitting a Moving Target: Endogenous Development in Marginal European Areas. 1996. Gaston G.A. Remmers.

64. Poverty, Pluralism and Extension Practice. 1996. Ian Christoplos.

65. Conserving India's Agro-Biodiversity: Prospects and Policy Implications. 1997. Ashish Kothari.

66. Understanding Farmers' Communication Networks: Combining PRA With Agricultural Knowledge Systems Analysis. 1997. Ricardo Ramirez.

67. Markets and Modernisation: New Directions for Latin American Peasant Agriculture. 1997. Julio A. Berdegué and Germán Escobar.

68. Challenging 'Community' Definitions in Sustainable Natural Resource Management: The case of wild mushroom harvesting in the USA. 1997. Rebecca McLain and Eric Jones.

69. Process, Property and Patrons: Land Reform In Upland Thai Catchments. 1997. Roger Attwater.

70. Building Linkages for Livelihood Security in Chivi, Zimbabwe. 1997. Simon Croxton and Kudakwashe Murwira.

71. Propelling Change from the Bottom-Up: Institutional Reform in Zimbabwe. 1997. J. Hagmann, E. Chuma, M. Connolly and K. Murwira.

72. Gender is not a Sensitive Issue: Institutionalising a Gender-Oriented Participatory Approach in Siavonga, Zambia. 1997. Christiane Frischmuth.

73. A Hidden Threat to Food Production: Air Pollution and Agriculture in the Developing World. 1997. F. Marshall, Mike Ashmore and Fiona Hinchcliffe.

74. Policy Research and the Policy Process: Do the Twain ever Meet? 1998. James L. Garrett and Yassir Islam.

75. Lessons for the Large-Scale Application of Process Approaches from Sri Lanka. 1998. Richard Bond.

76. Malthus Revisited: People, Population and the Village Commons in Colombia. 1998. Juan Camilo Cardenas.

77. Bridging the Divide: Rural-Urban Interactions and Livelihood Strategies. 1998. Cecilia Tacoli.

78. Beyond the Farmer Field School: IPM and Empowerment in Indonesia. 1998. Peter A. C. Ooi.

79 The Rocky Road Towards Sustainable Livelihoods: Land Reform in Free State, South Africa. 1998. James Carnegie, Mathilda Roos, Mncedisi Madolo, Challa Moahloli and Joanne Abbot.

80 Community-based Conservation: Experiences from Zanzibar. 1998. Andrew Williams, Thabit S. Masoud and Wahira J. Othman.

81 Participatory Watershed Research and Management: Where the Shadow Falls. 1998. Robert E. Rhoades.

82 Thirty Cabbages: Greening the Agricultural 'Life Science' Industry. 1998 William T. Vorley.

83 Dimensions of Participation in Evaluation: Experiences from Zimbabwe and the Sudan. 1999. Joanne Harnmeijer, Ann Waters-Bayer and Wolfgang Bayer

84 Mad Cows and Bad Berries. 1999. David Waltner-Toews.

85. Sharing the Last Drop: Water Scarcity, Irrigation and Gendered Poverty Eradication. 1999. Barbara van Koppen.

86. IPM and the Citrus Industry in South Africa. 1999. Penny Urquhart

87. Making Water Management Everybody's Business: Water Harvesting and Rural Development in India. 1999. Anil Agarwal and Sunita Narain

88. Sustaining the Multiple Functions of Agricultural Biodiversity. 1999. Michel Pimbert

Gatekeeper papers

can be purchased from IIED's bookshop. Contact The Bookshop, 3 Endsleigh Street, London WC1H ODD, UK.
Telephone: +44 (0)171 388 2117
Facsimile: +44 (0)171 388 2826
E-mail: bookshop@iied.org
Internet: http://www.iied.org/

For further information about the series contact:

The Sustainable Agriculture and Rural Livelihoods Programme at the same address, or e-mail: sustag@iied.org

Submitting papers to the *Gatekeeper Series*

We welcome contributions to the *Gatekeeper Series* from researchers and practitioners alike. The Series addresses issues of interest to policy makers relating to the broad area of sustainable agriculture and resource management. *Gatekeepers* aim to provide an informed briefing on key policy issues in a readable, digestible form for an institutional and individual readership largely comprising policy and decision-makers within aid agencies, national governments, NGOs and research institutes throughout the world. In addition to this primary audience, *Gatekeepers* are increasingly requested by educators in tertiary education institutions, particularly in the South, for use as course or seminar discussion material.

Submitted material must be of interest to a wide audience and may combine an examination of broad policy questions with the presentation of specific case studies. The paper should conclude with a discussion of the policy implications of the work presented.

Style

Gatekeepers must be short, easy to read and make simple, concise points.

- Use short sentences and paragraphs.
- Keep language simple.
- Use the active voice.
- Use a variety of presentation approaches (text, tables, boxes, figures/ illustrations, bullet points).
- Length: maximum 5,000 words

Abstract

Authors should also include a brief summary of their paper – no longer than 450 words.

Editorial process

Please send two hard copies of your paper. Papers are reviewed by the editorial committee and comments sent back to authors. Authors may be requested to make changes to papers accepted for publication. Any subsequent editorial amendments will be undertaken in consultation with the author. Assistance with editing and language can be provided where appropriate.

Papers or correspondence should be addressed to:

Gatekeeper Editor
Sustainable Agriculture and Rural Livelihoods Programme
IIED, 3 Endsleigh Street, London WC1H ODD, UK
Tel:(+44 171) 388 2117; Fax: (+44 171) 388 2826; e-mail: sustag@iied.org

iied

International Institute for Environment and Development

Sustainable Agriculture and Rural Livelihoods Programme

Sida

The Sustainable Agriculture and Rural Livelihoods Programme

The Sustainable Agriculture and Rural Livelihoods Programme of IIED promotes and supports the development of socially and environmentally aware agriculture through policy research, training and capacity strengthening, networking and information dissemination, and advisory services.

The Programme emphasises close collaboration and consultation with a wide range of institutions in the South. Collaborative research projects are aimed at identifying the constraints and potentials of the livelihood strategies of the Third World poor who are affected by ecological, economic and social change. These initiatives focus on the development and application of participatory approaches to research and development; resource conserving technologies and practices; collective approaches to resource management; the value of wild foods and resources; rural-urban interactions; and policies and institutions that work for sustainable agriculture.

The Programme supports the exchange of field experiences through a range of formal and informal publications, including *PLA Notes* (*Notes on Participatory Learning and Action* – formerly *RRA Notes*), the *IIED Participatory Methodology Series*, the *Working Paper Series*, and the *Gatekeeper Series*. It receives funding from the Swedish International Development Cooperation Agency, the British Department for International Development, the Danish Ministry of Foreign Affairs, the Swiss Agency for Development and Cooperation, and other diverse sources.

International Institute for Environment and Development
3 Endsleigh Street
London
WC1H 0DD

Tel: **(+44 171) 388 2117**
Fax: **(+44 171) 388 2826**
E-mail: **sustag@iied.org**

ISSN 1357-9258