



International
Institute for
Environment and
Development

GATEKEEPER SERIES

118

**FACING UP TO CLIMATE
CHANGE IN SOUTH ASIA**

Mozaharul Alam and
Laurel A. Murray

2005

THE GATEKEEPER SERIES of the Natural Resources Group at IIED is produced by the Sustainable Agriculture and Rural Livelihoods Programme. The Series aims to highlight key topics in the field of sustainable natural 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 and is supported by the Swedish International Development Cooperation Agency (Sida), the Swiss Agency for Development and Cooperation (SDC) and the Rockefeller Foundation. 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), Swedish International Development Cooperation Agency (Sida), the Swiss Agency for Development and Cooperation (SDC), the Rockefeller Foundation, or any of their partners.

MOZAHARUL ALAM is a Research Fellow at the Bangladesh Centre for Advanced Studies where he is working on global environmental change and sustainable development issues with a special focus on climate change impacts, vulnerability, adaptation and mainstreaming issues. He is also working on building the capacity of least developed countries in South Asia in the above areas. Bangladesh Centre for Advanced Studies, House 10, Road 16A, Gulshan-1, Dhaka 1212, Bangladesh. Tel: +880-2 885 1237; Fax: +880-2 885 1417; Email: mozaharul.alam@bcas.net

LAUREL A. MURRAY is a Researcher in the Environment, Politics and Development Group at the Department of Geography, King's College London. She is working on climate change policy and development, with a particular focus on international environmental agreements and the negotiation process. Environment, Politics and Development Group, Department of Geography, King's College London, Strand, London, WC2R 2LS, United Kingdom. Tel: +44 (0)20 7848 1669; Fax: +44 (0)20 7848 2287; Email: laurel.murray@kcl.ac.uk

EXECUTIVE SUMMARY

This paper provides an overview of the likely impacts of climate change on three of the least developed countries in South Asia: Bangladesh, Bhutan and Nepal. In these countries, climate change effects will include changes in temperature, distribution of rainfall, sea-level rise, and an increase in the frequency and intensity of extreme weather events. This will have direct impacts on climate-dependent activities in these countries (such as agriculture, hydropower, forest management and nature conservation). Adverse impacts of extreme events, particularly floods (riverine, coastal and glacier lake outburst), droughts, salinity and cyclones are of particular concern. In addition, climate change will have indirect, socio-economic consequences for health, education and security. These least developed countries are most at risk because of their high vulnerability and low adaptive capacity. Weak economies, inadequate infrastructure, poor social development, lack of institutional capacity and high dependence on natural resources all contribute to this vulnerability.

The most damaging impacts of climate change for all three countries will be to water resources and agriculture. The agricultural sector is the major source of employment for all three countries and it will remain so in the near future. Loss of both agricultural land and production will adversely affect people's livelihoods, especially among the rural poor. Within Bangladesh, the population living in coastal areas are likely to be most at risk, whereas in Nepal, people living in the Terai plain and hilly areas are most vulnerable. The western region of Bhutan is highly vulnerable to glacier lake outbursts with potential impacts on hydropower and agriculture.

The authors highlight some potential adaptation measures and strategies for the region to lessen the impacts of climate change, variability and extreme events. The goal is to demonstrate that governments and donor agencies must recognise the threat climate change poses to development prospects in South Asia, particularly in LDCs, and ensure that adaptation measures are formulated and integrated into the wider development agenda. Countries like Bangladesh have made it their goal to reduce the number of people living below the poverty line by 50%, as stated in the Poverty Reduction Strategy Paper and Millennium Development Goals. Climate change will jeopardise this noble ambition unless realistic adaptation measures are devised. In addition to mainstreaming adaptation to national and sectoral development policies and measures, other recommendations include: strengthening community-based adaptation measures which build on local experiences and existing strategies for coping with extreme events; enhancing early warning systems and preparedness; developing new agricultural varieties; adopting efficient water resource management both in the winter and monsoon seasons; and inter-agency coordination and cooperation.

FACING UP TO CLIMATE CHANGE IN SOUTH ASIA

Mozaharul Alam and Laurel A. Murray

INTRODUCTION

The Third Assessment Report of Working Group II of the Intergovernmental Panel on Climate Change (IPCC) predicted that climate change would impose significant stress on resources throughout Asia. The Asian region is home to more than 60% of the world's population; natural resources are already under stress, and the resilience of most sectors to climate change is poor. Many countries are socio-economically dependent on natural resources such as water, forest, grassland and rangeland, and fisheries, and changes to these resources as a result of climate change will have far-reaching implications. For example, food and fibre, biodiversity, water resources, coastal ecosystems and human settlements in South Asia are thought to be highly vulnerable to climate change. The impacts of climate change are expected to vary significantly across the different sub-regions and countries of Asia and certain countries will be able to cope better than others. The Least Developed Countries (LDCs), which are already struggling to tackle issues of poverty, health and education, are expected to be among the most vulnerable to climate change and extreme events because of their lack of economic strength, low level of institutional capabilities and greater dependence on climate-sensitive resources. It is vital that realistic measures for adapting to climate change are developed for these vulnerable countries and integrated into their wider development agenda.

This paper summarises an assessment made of three South Asian LDC countries, Bangladesh, Bhutan and Nepal (Alam, 2004a, b and c), carried out under the fellowship programme of the Capacity Strengthening of Least Developed Countries (LDCs) to Adaptation to Climate Change (CLACC) project. This project was implemented jointly by a group of Southern institutes under the leadership of the International Institute of Environment and Development (IIED). The assessment looked at climate change impacts on development and the integration of climate change adaptation policies. In this paper we first review the antic-

ipated climate change impacts for these three countries and their implications for development policies. We then highlight some potential adaptation measures and strategies for the region to lessen the impacts of climate change, variability and extreme events. Our goal is to demonstrate that governments and donor agencies must recognise the threat climate change poses to development prospects in South Asia, particularly in LDCs, and ensure that adaptation measures are formulated and integrated into the wider development agenda.

REGIONAL CHARACTERISTICS

Geophysical context

Geophysical characteristics vary significantly among the three LDC countries reviewed in this study (see map), ranging from Himalayan mountainous ecosystems to low-lying coastal ecosystems. The coastal zones, floodplains and inner mountainous areas with river valleys support most economic and cultural activity. Bangladesh is broadly divided into three geological land types: floodplain (80%), Pleistocene terrace (8%), and Tertiary hills (12%). Bhutan's land area can be divided into southern foothills, inner Himalayas and higher Himalayas. The southern foothills rise from the plains to a height of 1,500 metres but are only about 20 kilometres wide. The inner Himalayas gradually rise to about 3,000 metres and contain the broad river valleys of central Bhutan, the economic and cultural heartland of the country. The northern region comprises the main Himalayan range of the high mountains. In Nepal, the Terai plain, the Siwalik Hills, the Middle Mountains, the High Mountains (consisting of the Main Himalayas and the Inner Himalayan Valleys), and the High Himalayas all have distinguishing characteristics. The Terai region, where land is most suitable for cultivation, lies below 610 metres, comprises 23% of the total land area and contains 48% of the population (CBS, 2002).

Climatic context

South Asia's climate encompasses a wide range of altitudinal zones and microclimatic conditions. These range from tropical to arctic, creating highly diverse ecosystems. The region is characterised by very low to high temperatures, heavy rainfall, often excessive humidity and marked seasonal variations. The Himalayan mountain chain produces a more or less tropical climate throughout the year in Bangladesh. In Bhutan, there is a wide range of altitudinal variation, from tropical to temperate, over a short distance. The climate of Nepal

Socio-economic context

The total population of these three South Asian LDCs is roughly 155 million (Bangladesh: 131; Bhutan: 0.75; and Nepal: 23 million) with very low per capita GDP, ranging from US\$250 to 695 (UNDP, 2004). The population of the region is increasing, with significant variation in urban and rural population growth. It is estimated that the population of Bangladesh will be 170 million by the year 2020 (WB and BCAS, 1998). The population of Nepal is estimated to increase to between 29.87 and 34.56 million by 2016 (MoEP, 1998).

The Human Development Index (HDI) provides a measure of the status of human development within a country and represents life expectancy, literacy and standard of living (in terms of GDP per capita in purchasing power). Happily, all three countries have shown an increase in their HDI. For example, the HDI for Bangladesh has improved from 0.350 in 1980 to 0.509 in 2002, moving the country from a low human development category to a medium development category (UNDP, 2004). However, despite such improvement at the macroeconomic level, Bangladesh still faces significant challenges in combating poverty, with 36% of people living on US\$1 per day.

In contrast, extreme poverty is relatively rare in Bhutan and few suffer from hunger or homelessness. Life expectancy has risen from 37 years in 1960 to 66 years in 1997, while over the same period the proportion of the population with access to safe water has risen from 31% to 63% (TPCS, 2000). Nevertheless, the population still relies heavily on subsistence agriculture, and rural incomes and agricultural productivity are low.

Despite its natural beauty and enormous potential for hydropower and tourism, Nepal is one of the poorest countries with 82.5% of the population living below the international poverty line of US\$2 per day (World Bank, 2003). A Gini Coefficient of 0.37 indicates that income distribution is highly uneven. In fact, some 38% of the population survives on less than US\$1 per day. The wealthiest 20% of the population claims nearly 45% of total annual national income, while the poorest 20% can claim only 7.6%. Aggregate funding from various international agencies constitutes approximately 45% of Nepal's entire government expenditure (World Bank, 2002).

Economic context

Overall, macroeconomic stability and economic growth are improving in these three countries. GDP growth has increased steadily, ranging from 4 to 7%. Market

oriented economic reforms and deregulations in Bangladesh in the early 1990s have led to a more secure macroeconomic environment. The average annual GDP growth was 4.65% from 1991 through 1995 and rose to 5.49% from 1996 through 2000. The per capita Net National Income (NNI) rose from US\$317 in 1995 to US\$354 in 2000. Bhutan had an estimated GDP growth rate of 7.7% in 2002, higher than the 7.2% recorded in 2001. The per capita income of an average Nepalese is approximately US\$ 250 per annum. The size of the national GDP is approximately US\$5.5 billion with an annual average growth rate of 4.9%.

Agriculture and agricultural products contribute the greatest share of GDP in all three countries. In addition, agriculture also provides a livelihood for nearly three-quarters of the labour force. A heavy reliance on agriculture, as well as on other climate-sensitive sectors such as hydropower and tourism, make the economies in South Asia highly vulnerable to climate variability. The importance of other sectors in the three countries varies depending on resource availability and differences in economic activities. For example, tourism and power contribute significantly to economic growth in Nepal and Bhutan, respectively. On the other hand, the service sector has become an important contributor to the GDP of Bangladesh.

DEVELOPMENT GOALS

Poverty alleviation and improved well-being are two common and overarching development goals for all three countries. However, indicators, means, and strategies for achieving these objectives differ considerably for each individual country. Bangladesh's Poverty Reduction Strategy Paper (PRSP) follows the Millennium Development Goals (MDGs)—to halve poverty by 2015, while Nepal's Tenth Plan seeks to reduce poverty by 8% (from 38% to 30% of the population) between 2002 and 2007. Nepal also aims for a 10% improvement in human development indicators and a 6.2% increase in the economy. Gross National Happiness is Bhutan's overarching development philosophy. The country's Ninth Plan has noted that while Bhutan is prepared for change, it is essential to have a clear-cut perspective on the objectives and the guiding principles for change. The country's development goals place an emphasis on holistic development, advocating that growth must be both social and economic and placing equal importance on spiritual, emotional and cultural needs, on the one hand, and the material well-being of society on the other.

Bangladesh's poverty alleviation programme prioritises human resources development and education. It is increasingly being recognised in Bangladesh that envi-

ronmental concerns must be integrated, or mainstreamed, into all development activities. Specific environmental actions required for sustainable development also include community participation in local level planning and management of local resources. In Bhutan, having accepted that the maximisation of Gross National Happiness is a philosophy, the Government has identified four areas as the main pillars for development: (a) economic growth and development; (b) preservation and promotion of cultural heritage; (c) preservation and sustainable use of the environment; and (d) good governance. Nepal's strategy for achieving its objectives is based on the "Four Pillars" of poverty reduction which are (a) broad-based economic growth; (b) social sector development, including human development; (c) targeted programmes for underprivileged groups; and (d) good governance.

Development challenges

There are many driving forces in all three countries compelling people to over-exploit their natural resources. These include poverty combined with rapid population growth, high levels of unemployment or under employment, natural disasters, low levels of education, and lack of institutional capability. Unplanned agricultural practices and encroachment on forest areas for agriculture and settlement also put increased pressure on resources. Unplanned or inadequate rural infrastructure development and the growing demands of increasing urbanisation are also devouring productive land. The major threat to Bangladesh agriculture is that production is becoming less and less competitive. Overall, production costs are increasing, making investment in agriculture less attractive, and thus affecting total production. Furthermore, land degradation, extreme floods and poor water availability in the dry season are undermining agricultural production and food self sufficiency.

A major economic challenge for Bhutan stems from it being a least developed economy with special structural constraints and vulnerabilities. The direct linkage of the Bhutanese currency to the Indian rupee, combined with large inflows of foreign aid and hydropower revenue, push up the wages of unskilled workers, making exports (except from hydropower) less competitive and hampering efforts to diversify the economy. Moreover, Bhutan faces unique challenges being a land-locked country with a mountainous topography and scattered settlements, resulting in higher costs for social services and infrastructure development. This also has increased pressure on the national budget, diverting resources from direct investment in production.

Box 1: Coastal zone vulnerability in Bangladesh

Several studies have shown that coastal zone vulnerability would be acute due to the combined effects of climate change, sea level rise, subsidence, and changes of upstream river discharge, cyclone, and coastal embankments. There are four key primary physical effects (WB, 2000):

- The effect of *saline water intrusion* in the estuaries and into the groundwater would be stimulated by low river flow, sea level rise and subsidence. Pressure of the growing population and economic development will further reduce fresh water availability in future. The adverse effects of salt-water intrusion will be significant on coastal agriculture and the availability of fresh water for public and industrial water supply.
- The combined effect of higher sea water levels, subsidence, siltation of estuary branches, higher riverbed levels and reduced sedimentation in flood-protected areas will impede drainage and will gradually *increase waterlogging problems*. The problem will be aggravated by the continuous development of infrastructure (e.g. roads), reducing further the limited natural drainage capacity in the delta. Increased periods of inundation may hamper agricultural productivity, and will also threaten human health by increasing the potential for water borne disease.
- *Disturbance of coastal morphological processes* would become a significant problem under a warmer climate. Bangladesh's coastal morphological processes are extremely dynamic, partly because of the tidal and seasonal variations in river flows and run off. Climate change is expected to increase these variations, with two main (related) processes involved:
 - Increased bank erosion and bed level changes of coastal rivers and estuaries.
 - Disturbance of the balance between river sediment transport and deposition in rivers, flood plains, and coastal areas.
- *Increased intensity of extreme events*. The coastal areas of Bangladesh and the Bay of Bengal are located at the tip of northern Indian Ocean and are frequently hit by severe cyclonic storms, generating long wave tidal surges which are aggravated because the Bay itself is quite shallow. Cyclones and storm surges are expected to become more intense with climate change. Though the country is relatively well equipped in one aspect of disaster management, increased intensity of the disasters implies major constraints to the country's social and economic development.

In Nepal, apart from an urgent need to address the issues of political stability, domestic security and conflict mitigation, which obstruct poverty reduction and economic growth, the main challenge will be to increase the performance of the agricultural sector. In particular, poor farmers need both encouragement to change their practices (for example, to diversify their crops) and improved access to agricultural infrastructure and facilities such as water and credit. Furthermore, basic social services in the rural areas urgently need to be improved. Enforcing existing environmental laws would go a long way to curb environmental degradation, as well as targeting polluting industries and assisting in their relocation.

Improving governance and diminishing corruption is also a major requirement for enhancing development in all three South Asian countries. Good governance is an essential precondition for a fairer and more successful development policy based on comprehensive civil service reforms to increase efficiency and accountability both at central and local levels.

IMPACTS OF CLIMATE CHANGE

In the last decade, a number of studies have been carried out on climate change impacts, vulnerability and adaptation measures for Bangladesh, Bhutan and Nepal. Key climate change related studies include a) climate change country study under US climate change study programme (Huq *et al.*, 1999); b) initial national communication to the United Framework Convention on Climate Change (DoE, 2002); and c) OECD studies on Bangladesh and Nepal in 2003 (Shardul *et al.*, 2003a and 2003b). Assessments for Bangladesh have also considered sea-level rise, which is another important aspect of climate change in this country. The most damaging impacts of climate change for all three countries will be to water resources and agriculture, and through natural disasters such as floods, droughts and glacier lake outbursts. These events already drastically affect crop productivity almost every year.

Water resources

Water related impacts of climate change and sea level rise are likely to be some of the most critical issues for Bangladesh. Climate change is predicted to increase both coastal (from sea and river water) and inland flooding (river/rain water) in Bangladesh (Box 1). In addition, changes of the riverbed from sedimentation and changes in morphological processes due to seasonal variation of water level and flow will also be serious. A combination of development and climate change scenarios indicates that the Lower Ganges and the Surma floodplains of Bangladesh will be the most vulnerable. On the other hand, the north-central region may become flood-free if the major rivers have embankments built—something which has been considered under some development scenarios. The possibility of winter (dry season) drought will increase in certain areas.

There are numerous snow-clad mountains and glacial lakes in the northern region of Bhutan. Increases in temperature caused by global warming will result in the retreat of glaciers, increasing the volume of such lakes and ultimately provoking glacial lake outburst floods (GLOFs) with potentially catastrophic consequence. The October 1994 flash flood on the Pho Chhu River following a glacial lake

outburst in the Lunana area was one such example. Impacts include disruption to the quantity of river water used for hydropower generation; destruction of settlements, infrastructure, and agricultural lands; and loss of biodiversity and even human lives downstream.

In Nepal, geoscientists have also noted that the number and volume of GLOF hazards is growing. Some of these floods have produced discharge rates of up to 30,000 m³/sec and can run for distances of 200 km (Richardson and Reynolds, 2000). In the past, these disasters have caused enormous destruction. The most significant documented GLOF event occurred in Nepal in 1985 and resulted in extensive damage. This GLOF caused a 10 to 15 metre high surge of water and debris to flood down the Bhote Koshi and Dudh Koshi Rivers for 90 kilometres. At its peak, 2,000 m³/sec was discharged; two to four times the magnitude of maximum monsoon flood levels. It destroyed the Namche Small Hydel Project, which was almost near completion at the time, and cost approximately NPR 45 million. Moreover, limited opportunities for safe and sustainable livelihoods in the mountains mean that population densities are growing within the river valleys where the vulnerability to GLOFs increases. The population growth means that there are now more people exposed to GLOFs and other climate-related disasters, and this is compounded by the expansion of infrastructure and settlements in the vulnerable areas.

Some climate models predict an increase in rainfall intensity, which may increase runoff, enhance soil erosion on cleared land and accelerate sedimentation in the existing water supplies or reservoirs. Not only will this reduce the potential of a catchment to retain water, but it will also cause water quality to deteriorate. A reduction in the average flow of snow fed rivers, combined with an increase in peak flows and sediment yield, would have major impacts on hydropower generation, urban water supply and agriculture.

Agriculture

The agricultural sector is the major source of employment for all three countries and will remain so in the coming decades. Loss of both agricultural land and production will adversely affect people's livelihoods, especially among the rural poor. Under a severe climate change scenario (a 4 degree centigrade temperature rise, increased evaporation of 22%), the potential shortfall in rice production in Bangladesh could exceed 30%, while that for wheat and potato could be as high as 50 and 70%, respectively (Karim, 1996). Even under a moderate climate change

scenario the crop loss due to salinity intrusion could be 0.2 Mt annually (Habibullah *et al.*, 1999). The anticipated drop in agricultural production, when coupled with losses in other sectors, will have a deep impact on the development prospects for these South Asian countries, severely threatening food security. The ultimate impact of loss of food grain production would be to use hard currency to increase food imports.

For Bhutan, a temperature increase of 2⁰C would shift the cultivation zone for crops sensitive to low temperatures into higher elevations. Although this may seem a positive spinoff, the steep slopes at this altitude are unsuitable for agriculture. Related cropping patterns would be affected and there is likely to be further degradation of hill ecosystems.

Nepal has a high dependency on agriculture and over 80% of all water in the country is used for irrigation. Higher temperatures, increased evapo-transpiration and decreased winter precipitation may bring about more droughts. Studies in Southwest Asia show that decreased winter snowfall on glaciers does indeed decrease the spring/summer runoff. This has already caused severe droughts in Iran and Pakistan in areas that depend on water from mountain sources (Subbiah, 2001). A similar pattern would severely affect irrigation and farming livelihoods in Nepal. The land that can be cultivated varies by location and season, since the vast majority of surface water irrigation systems in Nepal depend on the water flowing at its source (USCSP, 1997). In some cases, the winter cropping area is only 20% of the cultivable area during the summer.

Some predict some positive impacts on agriculture from climate change and its causes, such as increased temperatures and higher carbon dioxide levels. While these may have positive impacts on crop yields, this is only where moisture is not a constraint. For example, the apparent increase in Boro yield in Bangladesh as a result of increased carbon dioxide would be constrained by moisture stress. A 60% moisture stress on top of other effects might cause as high as a 32% decline in Boro yield, instead of having an overall 20% net increase (Karim *et al.*, 1999). It is feared that moisture stress would be more intense during the dry season, which might force Bangladeshi farmers to reduce the area for Boro cultivation altogether. Warmer temperatures may also increase the occurrence of extreme events or pests, again offsetting any potential benefits. Both crops and livestock would be affected by an increase in disease or alien/invasive pests. An increase in temperature, despite a reduction in humidity, can reduce the ability of farmers to work. As a result, low-

income rural populations that depend on traditional agricultural systems or on marginal lands are particularly vulnerable to climate change and livelihoods will be at risk.

MAINSTREAMING ADAPTATION TO CLIMATE CHANGE

The overall impacts of climate change will be far-reaching. Countries such as Bangladesh have made it their goal to reduce the number of people living below the poverty line by 50%, as stated in the PRSPs and Millennium Development Goals. Climate change will jeopardise this noble ambition unless realistic adaptation measures are devised. Moreover, climate change may have other, more indirect consequences for these countries. Following past extreme events, the poverty driven rural population has migrated to urban centres. Such large-scale inter-community migration is likely to increase social unrest and exacerbate existing conflict situations.

National and international agencies are beginning to recognise the extent to which climate change will affect development in South Asia. The next step is to make a shift from policy to action and develop realistic adaptation strategies that are integrated into existing development initiatives. Current and planned development projects could either increase or reduce the vulnerability of communities to climate variability, depending on how well they consider climatic impacts. To ensure the success of both climate change and development programmes, adaptation measures must be mainstreamed into existing development strategies, across all levels and sectors. This will require the participation and cooperation of different stakeholders, including government policy-makers, implementing agencies, development partners, the private sector and communities.

In Bangladesh, Bhutan and Nepal, government initiatives and donor projects still pay little attention to climate change, instead focusing on one-off extreme weather events such as floods, droughts and cyclones. However, while Bangladesh's National Water Policy (NWP) and National Water Management Plan (NWMP) do not mention climate change *explicitly*, they will, nevertheless, aid in the adaptation to climate change through emphases on:

- Developing early warning and flood-proofing systems to manage floods and droughts (both expected to increase under climate change).
- “*Comprehensive development and management of the main rivers through a system of barrages*” to help sustain dry season flows and regulate monsoon

flooding. This is also synergistic with adaptation measures for the water sector as it will help reduce salinity concerns in the Sundarbans during the dry season and enhance their resilience under climate change and sea level rise.

- Regional co-operation among co-riparian countries; a good institutional adaptation response.

It is important to note that several donors and governments are in fact actively engaged in projects to reduce the risk of GLOFs (Box 2); however, over the next decade these activities must be scaled up. In the case of Bhutan and Nepal, several strategies mention the mitigation potential within the forestry and hydropower sectors to reduce global greenhouse gas emissions that cause climate change, but the focus of these LDCs should be on adaptation. Ignoring the importance of climate induced impacts and the need for adaptation will hinder progress towards overall growth and sustainable development.

Box 2: Reducing the risk of GLOFs in Nepal

Nepal is starting to reduce the risks of GLOFs by draining water from glacier lakes using siphons or pumps, cutting drainage channels for periodic water release, and building flood control measures downstream (Rana *et al.*, 2000). With the support of The Netherlands, the government began a project to drain the Tsho Rolpa glacial lake by three metres, which reduced the risk of a GLOF by 20%. A channel was cut into the moraine, and a gate was constructed to allow water to be released as necessary. The four year project cost US\$3.2 million. Nepal's Tenth Plan aims to improve the country's ability to use existing water resources to provide farmers with year-round irrigation. An advantage of large hydropower reservoirs is that these reservoirs can provide dependable flows for electricity generation, supplement water supplies for domestic and agriculture uses during the dry season, and if properly designed, play a role in flood management. However, these possible benefits must be carefully weighed against the environmental impacts and the enhanced GLOF risks.

Concluding remarks

Each country has identified a number of measures to reduce adverse impacts of climate change. Noteworthy interventions include:

- improving observation, forecasting and early warning systems
- establishing hazard and vulnerability mapping
- fostering community involvement and awareness raising

- improving operation and maintenance of existing water infrastructure
- improving irrigation efficiency
- developing varieties of crops and livestock with greater resilience to limited arable land and extreme conditions
- creating community-based forest management and afforestation projects

Countries have also identified physical adaptation measures, including engineering projects, to reduce vulnerability, particularly to reduce flood impacts and improve drainage conditions. These are typically more expensive measures that address a specific problem, but they can also produce multiple uses and benefits. A World Bank study (World Bank, 2000) on Bangladesh identified physical measures including full flood protection and controlled flooding, augmentation of surface water, desalinisation, tidal basin management, construction of water infrastructure etc.

There are also institutional issues to be addressed for enhancing effectiveness of strategies and measures with cross-cutting benefits. Specifically, the region needs to:

- increase public awareness
- improve inter-departmental coordination
- establish regional collaboration
- enhance collaborative research and training
- set-up international partnerships, capacity building, and assistance

The National Adaptation Programmes of Action to Climate Change (NAPA) in all three South Asian countries are the first attempt to bring together different stakeholders, including the government and civil society, to discuss adverse impacts of climate change and formulate nation-wide strategies for addressing adaptation. For example, Bangladesh's NAPA process has brought together key sectoral agencies such as the Water Resources Planning Organisation and

Bangladesh Agricultural Research Council with non-government organisations like the Bangladesh Centre for Advanced Studies (BCAS) to formulate the plan. NAPAs will also need to review existing strategies for coping with climatic stresses and investigate how these current strategies can be strengthened and built upon. For the least developed countries, the NAPA process can be an important opportunity, not only to address vulnerability and adaptation to climate change, but also to marry adaptation and development agendas. Lastly, many projects are currently being carried out in all three South Asian countries that provide win-win opportunities for developing measures for climate adaptation and development (Box 3). Such initiatives should be encouraged, and continuous persuasion of policy makers in all government branches is needed.

Box 3: Comprehensive Disaster Management Programme, Bangladesh

The Comprehensive Disaster Management Programme (CDMP) is a collaborative effort by the Bangladesh Government, United Nations Development Programme, the UK Department of International Development and a host of disaster management stakeholders to design a programme built upon critical lessons learned over the past decade. The programme advocates a policy and management shift from relief and recovery operations to a more holistic approach of forecasting and community preparedness. The components will address the mainstreaming of disaster management within development and investment programmes; the strengthening of community institutional mechanisms; expanding preparedness programmes to cover existing and new hazards; implementing a skill development programme to raise the standard of disaster management efforts at all levels; and studying the key urban risk management challenges. The CDMP takes into consideration the vulnerability of the poor and common people from climatic events like flood and cyclone and long-term climate change impacts.

REFERENCES

- Alam, M. 2004a. *Bangladesh Country Assessment Report on Adverse Impacts of Climate Change on Development: Integrating Adaptation into Policies and Activities*, July 2004. In press.
- Alam, M. 2004b. *Bhutan Country Assessment Report on Adverse Impacts of Climate Change on Development: Integrating Adaptation into Policies and Activities*, July 2004. In press.
- Alam, M. 2004c. *Nepal Country Assessment Report on Adverse Impacts of Climate Change on Development: Integrating Adaptation into Policies and Activities*, July 2004. In press.
- CBS. 2002. *A Statistical Pocket Book of Nepal*. CBS, Kathmandu.
- DoE. 2002. *Initial National Communication in Response to United Nations Framework Convention on Climate Change*. Department of Environment, Ministry of Environment and Forests, Dhaka, Bangladesh.
- Habibullah, M., Ahmed, AU. and Karim, Z. 1999. Assessment of food grain production loss due to climate induced soil salinity: a case study. In: S. Huq, Z. Karim, M. Asaduzzaman and F. Mahtab (Eds.) *Vulnerability and Adaptation to Climate Change for Bangladesh*. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- Karim, Z., 1996. Agricultural vulnerability and poverty alleviation in Bangladesh. In: TE. Downing (Ed.) *Climate Change and World Food Security*. NATO ASI Series, 137. Springer-Verlag, Berlin, Hiedelberg.
- Karim, Z. Sk Ghulam, H. Ahsan, A. U. 1999. Climate Change Vulnerability of Crop Agriculture. In: S. Huq, Z. Karim, M. Asaduzzaman and F. Mahtab (Eds.) *Vulnerability and Adaptation to Climate Change for Bangladesh*. Kluwer Academic Publishers, Dordrecht, The Netherlands.
- MoEP. 1998. Website of Ministry of Environment and Population, Nepal. <http://www.mope.gov.np/population/population.php>
- Rana, B., Shrestha, AB. Reynolds, JM. Aryal, R., Pokhrel, AP. and Budhathoki, KP. 2000. Hazard assessment of the Tsho Rolpa Glacier Lake and ongoing remediation measures. *Journal of Nepal Geological Society* 22: 563-570.
- Richardson, S. and Reynolds, J. 2000. An overview of glacial hazards in the Himalayas. *Quaternary International* 65/66 (2000): 31-47.
- Huq, S., Karim, Z., Asaduzzaman, M. and Mahtab, F. (eds). 1999. *Vulnerability and Adaptation to Climate Change for Bangladesh*. Kluwer Academic Publishers, The Netherlands.
- Shardul, A., Tomoko, O., Ahsan Uddin, A., Smith, J. and van Aalst, M. 2003a. *Development and Climate Change in Bangladesh: Focus on Coastal Flooding and the Sundarbans*, OECD, Paris.
- Shardul, A., Vivian, R., Maarten, Van Aalst, Larsen, P., Smith, J. and Reynolds, J. 2003b. *Development And Climate Change In Nepal: Focus on water resources and hydropower*. OECD, Paris.
- Subbiah, 2001. *Climate Variability and Drought in Southwest Asia*. Asian Disaster Preparedness Center, Bangkok.
- TPCS. 2000. *Bhutan National Human Development Report: 2000: Gross National Happiness and National Development- Searching for the Common Ground*. The Planning Commission Secretariat, Royal Government of Bhutan.
- UNDP. 2004. *Human Development Report: 2004*. United Nations Development Program (UNDP), Oxford University Press, New York.

USCSP. 1997. Country Study Team–Nepal. 1997. *Climate Change Vulnerability and Adaptation: Nepal Water Resources*. Prepared as part of the US Country Studies Program, Washington, DC.

World Bank and BCAS. 1998. Bangladesh 2020: A Long-run Perspective Study, The World Bank and Bangladesh Centre for Advanced Studies (BCAS). The University Press Limited, Dhaka, Bangladesh.

World Bank. 2003. *World Development Report 2003: Sustainable Development in a Dynamic World*. Oxford University Press, New York.

World Bank. 2002. *World Development Indicators*. CD Rom. World Bank, Washington, DC.

World Bank. 2000. *Bangladesh: Climate Change and Sustainable Development. Report No. 21104-BD*. Rural Development Unit, South Asia Region, The World Bank (WB), Dhaka.

SUBSCRIBING TO THE GATEKEEPER SERIES

To receive the Gatekeeper Series regularly, individuals and organisations can take out a subscription. Subscribers receive nine Gatekeeper papers a year. Subscriptions are free. For more details or to subscribe contact: IIED, 3 Endsleigh Street, London, WC1H 0DD, UK. Email gatekeeper@iied.org Tel: +44 020 7388 2117; Fax +44 020 7388 2826, or complete the online order form at <http://www.iied.org/>

OTHER IIED PUBLICATIONS

For information about IIED's other publications, contact: EarthPrint Limited, Orders Department, P.O. Box 119, Stevenage, Hertfordshire SG1 4TP, UK
 Fax: +44 1438 748844
 mail to: orders@earthprint.co.uk
 There is a searchable IIED bookshop database on: <http://www.iied.org/bookshop/index.html>

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. Angélique 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-Kwan 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 Zwart-eeven.
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. Kerj, 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 Christopolos.
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 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 Canillo 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.
89. **Demystifying Facilitation in Participatory Development.** 2000. Annemarie Groot and Marleen Maarleveld.
90. **Woodlots, Woodfuel and Wildlife: Lessons from Queen Elizabeth National Park, Uganda.** 2000. Tom Blomley.
91. **Borders, Rules and Governance: Mapping to catalyse changes in policy and management.** 2000. Janis B. Alcorn.
92. **Women's Participation in Watershed Development in India.** 2000. Janet Seeley, Meenakshi Batra and Madhu Sarin.
93. **A Study of Biopesticides and Biofertilisers in Haryana, India.** 2000. Ghayur Alam.
94. **Poverty and Systems Research in the Drylands.** 2000. Michael Mortimore, Bill Adams and Frances Harris.
95. **Forest Management and Democracy in East and Southern Africa: Lessons From Tanzania.** 2001. Liz Alden Wily.
96. **Farmer Learning and the International Research Centres: Lessons from IRRI.** 2001. Stephen Morin, Florencia Palis, Karen McAllister, Aida Papag, and Melina Magsumbol.
97. **Who Benefits From Participatory Watershed Development? Lessons From Gujarat, India.** 2001. Amita Shah.
98. **Learning Our Way Ahead: Navigating Institutional Change and Agricultural Decentralisation.** 2001. Clive Lightfoot, Ricardo Ramirez, Annemarie Groot, Reg Noble, Carine Alders, Francis Shao, Dan Kisauzi and Isaac Bekalo.
99. **Social Forestry versus Social Reality: Patronage and community-based forestry in Bangladesh.** 2001. Niaz Ahmed Khan.
100. **Global Restructuring, Agri-Food Systems and Livelihoods.** 2001. Michel P. Pimbert, John Thompson and William T. Vorley with Tom Fox, Nazneen Kanji and Cecilia Tacoli.
101. **Social Networks and the Dynamics of Soil and Water Conservation in the Sahel.** 2001. Valentina Mazzucato, David Niemeijer, Leo Stroosnijder and Niels Röling.
102. **Measuring Farmers' Agroecological Resistance to Hurricane Mitch in Central America.** 2001. Eric Holt-Giménez.
103. **Beyond Safe Use: Challenging the International Pesticide Industry's Hazard Reduction Strategy.** 2001. Douglas L. Murray and Peter L. Taylor.
104. **Marketing Forest Environmental Services – Who Benefits?** 2002. Natasha Landell-Mills.
105. **Food Security in the Context of Crisis and Conflict: Beyond Continuum Thinking.** 2002. Benedikt Korf and Eberhard Bauer.
106. **Should Africa Protect Its Farmers to Revitalise Its Economy?** 2002. Niek Koning.
107. **Creating Markets with the Poor: Selling Treadle Pumps in India** 2003. Frank van Steenberg.
108. **Collaborative Forest Management in Kyrgyzstan: Moving from top-down to bottom-up decision-making.** 2003. Jane Carter, Brieke Steenhof, Esther Haldimann and Nurlan Akenshaev.
109. **The Contradictions of Clean: Supermarket Ethical Trade and African Horticulture.** 2003. Susanne Freidberg.
110. **Risking Change: Experimenting with Local Forest Management Committees in Jamaica.** 2003. Tighe Geoghegan & Noel Bennett.
111. **Contract Farming in India: Impacts on women and child workers.** 2003. Sukhpal Singh.
112. **The Major Importance of 'Minor' Resources: Women and Plant Biodiversity.** 2003. Patricia Howard.
113. **Water For All: Improving Water Resource Governance in Southern Africa.** 2004. Emmanuel Manzungu.
114. **Food Industrialisation and Food Power: Implications for food governance.** 2004. Tim Lang.
115. **Biodiversity planning: Why and how should local opinions matter?** 2004. Sonja Vermeulen.
116. **Laws, lore and logjams: Critical issues in Indian forest conservation** 2005. Madhu Sarin.
117. **Adapting to Climate Change in East Africa: A strategic approach** 2005. Victor A. Orindi and Laurel A. Murray.
118. **Facing up to Climate Change in South Asia.** 2005. Mozaharul Alam and Laurel A. Murray.

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 or an electronic version 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. All illustrations and graphs, etc. should be supplied separately in their original format (e.g. as jpeg files) as well as being embedded within documents. This will allow us to modify the images where necessary and ensure good reproduction of the illustrations in print.

Papers or correspondence should be addressed to:

Gatekeeper Editor

Sustainable Agriculture and Rural

Livelihoods Programme

IIED, 3 Endsleigh Street,

London WC1H 0DD,

UK

Tel: (+44 020) 7388 2117;

Fax: (+44 020) 7388 2826;

e-mail: gatekeeper@iied.org

THE NATURAL RESOURCES GROUP (NR Group) at IIED was set up as a way to bring together the work on natural resources being done by different parts of the institute, and to serve as a fertile ground for going beyond departmental or sectoral boundaries on these issues. The NR group comprises the following programmes at IIED: Sustainable Agriculture and Rural Livelihoods; Forestry and Land Use; Biodiversity and Livelihoods; Climate Change; Strategies, Planning and Assessment; and Drylands. The NR Group works on a gamut of natural resources issues, including water, assessment of natural resources, co-management, international conventions, and urban issues. The Group seeks to explore the development of socially and environmentally aware natural resources management through policy research, training and capacity strengthening, networking and information dissemination, and advisory services.

The **SUSTAINABLE AGRICULTURE AND RURAL LIVELIHOODS PROGRAMME** coordinates the editorial process for the Series. The Programme seeks to enhance and promote understanding of environmental health and equity in agriculture and food systems. It 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 NR group receives funding from the Swedish International Development Cooperation Agency.

ISSN 1357-9258



International
Institute for
Environment and
Development

International Institute for Environment and Development

3 Endsleigh Street, London WC1H 0DD

Tel: (+44 020) 7388 2117

Fax: (+44 020) 7388 2826

E-mail: sustag@iied.org

Website: <http://www.iied.org/>