

# Adaptive Capacity and Livelihood Resilience

ADAPTIVE STRATEGIES FOR RESPONDING TO FLOODS AND DROUGHTS IN SOUTH ASIA

Marcus Moench and Ajaya Dixit  
EDITORS

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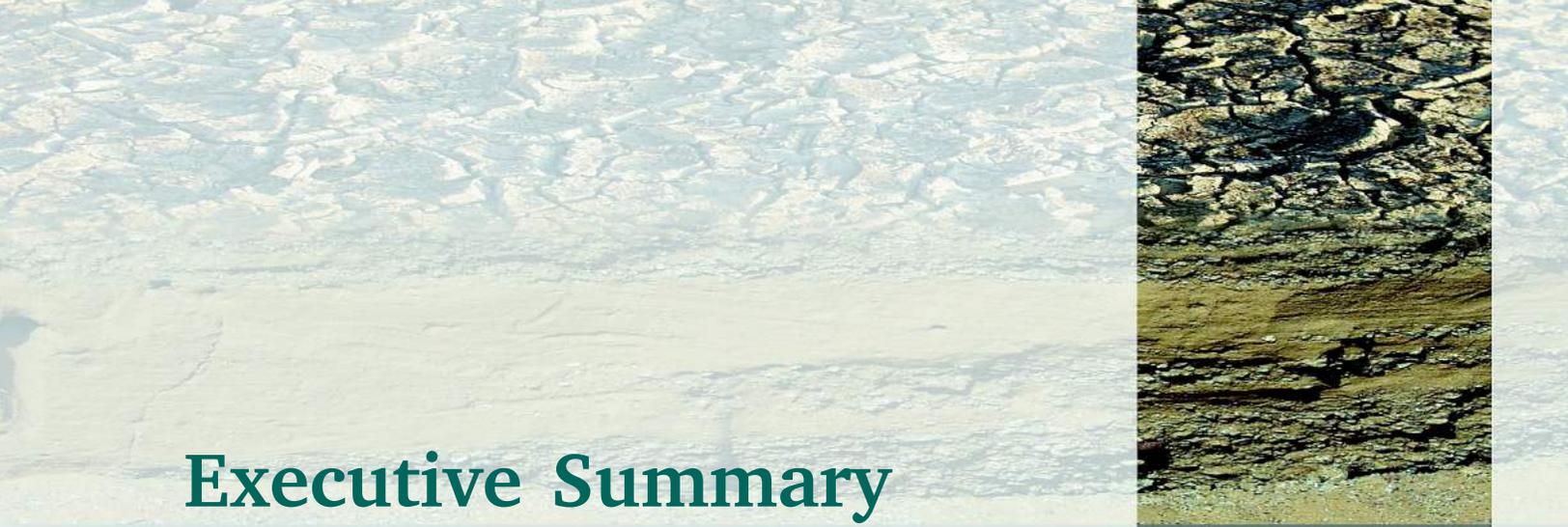
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# Executive Summary

## **Disasters are the unfinished business of development** *(Duryog Nivaran)*

Change is inherent to the human context. Whether the need is catalysed by extreme events such as floods, droughts and economic collapse or more gradual processes of change in environmental, technological or economic systems, we survive via adaptation. Strengthening the adaptive capacity of populations at all levels from the local to the global is, as a result, among the most important challenges facing development. The results of our research point, among other things, to the critical importance of trans-boundary flows of information, funds, goods, services, ideas and often people in determining the adaptive capacity of local populations. The ability to adapt to local problems such as floods and droughts often depends on systems and flows that connect to regional and global levels. Understanding this and addressing the inherent implications for trade, migration and other sensitive global policy arenas is, perhaps, one of the most significant challenges facing society in the coming century.

The Adaptive Strategies Project is the result of a unique collaboration between local grassroots organisations, regional non-government organisations (NGOs), academic institutions and international organisations working across South Asia. It represents an initial attempt to understand and disaggregate the factors which enable communities to adapt to floods, droughts and climatic variability *by examining the courses of action households actually take during flood and drought events* and locating the insights generated in a wider review of regional trends, government programmes and systems theory. Although focused on floods and droughts, many of the insights generated through the research have potential relevance for other contexts where livelihood systems are disrupted and adaptation is essential. Results of the study indicate that vulnerability and adaptive capacity in flood and drought contexts are heavily influenced by at least eight factors:



*In many localities communities have limited opportunities of diversifying livelihood.*

**Social capital and institutional checks and balances are important.**

1. The nature of livelihood systems within a region; more specifically the extent to which individuals and households are able to diversify income strategies and incorporate non-farm components which tend to be less vulnerable to flood and drought than agriculture;
2. The ability of people to migrate or commute in order to obtain access to non-farm or agricultural sources of income outside of drought- and flood-affected areas;
3. The ability of information, goods and services to flow into and out of affected areas;
4. The social capital and institutional checks and balances that households have access to including education, community institutions such as self-help groups (SHGs), formal institutions such as government departments and banks, NGOs, the media and social networks;
5. Existing patterns of vulnerability created by gender, income and social position;
6. The nature of physical infrastructure (roads, houses, water supply systems, etc.), in particular:
  - a. the degree to which such infrastructure is vulnerable to

- disruption by floods and droughts; and
  - b. the extent to which such infrastructure promotes the maintenance of livelihoods during drought and flood periods by serving as a point of refuge, helping to protect assets, and facilitating the movement of goods, services and people;
- 7. The ability of households in regions to obtain secure sources of water for domestic uses, whether from local or trans-boundary sources, water markets or rural supply schemes; and
- 8. Natural resource conditions, particularly the degree to which ground and surface water systems have been disrupted. Specific indicators of disruption include:
  - a. Long-term decline in water level is a major warning signal to irrigated agricultural systems of increasing drought vulnerability;
  - b. The increased presence of structures (such as roads, bridges, railway and flood control embankments) that interfere with the existing pattern of natural drainage, an indicator of the potential for increased flooding.

Case studies conducted in drought- and flood-affected regions of India and Nepal clearly indicate that income diversification, particularly the development of non-farm sources of

income, is the primary avenue by which households are able to maintain their livelihoods when floods and droughts occur. Whether this is achieved by establishing a business, securing outside jobs abroad or in cities or simply participating in regional labour markets, diversification provides access to secure income streams that can be used to maintain consumption, avoid debt, rebuild agricultural activities and retain or rebuild assets. Because agriculture is inherently vulnerable to flood and drought, diversification into non-agricultural activities is, in fact, often essential in order to ‘ride out’ bad years. The ability to diversify is, as a result, critical to the maintenance of rural agricultural livelihood systems.

The need to diversify income underlies the central role of migration and commuting in the adaptive strategies households follow to reduce the impact of extreme climatic events. Migration

**The ability to diversify is critical to the maintenance of rural agricultural livelihood systems.**



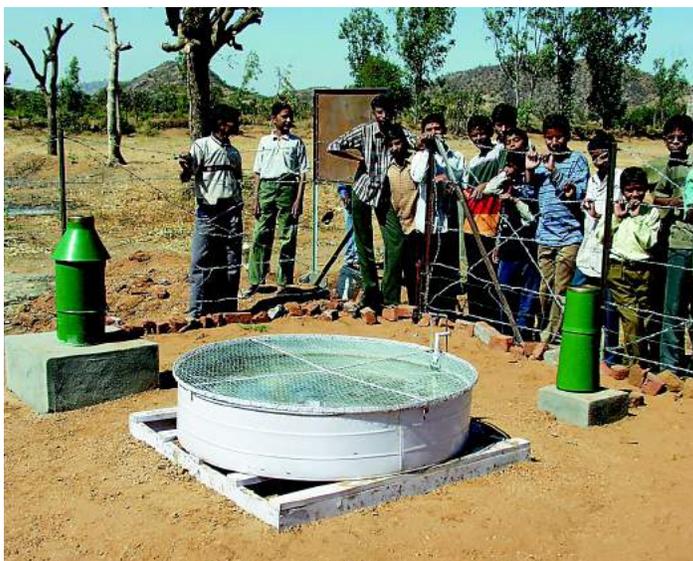
*Flooding limits local mobility.*

and commuting help households obtain access to income streams that are unaffected by droughts and floods. They are a core strategy required to manage the risk. The fact that much migration is long-term and driven by a wide variety of factors (such as the growth and diversification of national economies, and the degradation of traditional livelihoods) only increases its role in flood and drought mitigation. As farmers in Western Rajasthan and Gujarat stated during our interviews: *‘What is drought? It is always dry here....Drought is when my son in the city loses his job!’* This is not to say that all migration is good. Displacement caused by drought, flood or any other disaster often leads to impoverishment. Even so the role migration plays in maintaining the livelihood of rural populations cannot be disputed. The flow of people across rural and urban boundaries, districts, states and national borders provides access to a diverse bundle of livelihood strategies that are absent in many rural

areas. Migration, whether or not it is directly related to any given flood or drought event, enables people to adapt to change and extreme events. It is a central structural feature in global trends toward urbanisation and peri-urbanisation.

Flows of goods, services, finances and information are as important as flows of people in determining the adaptive capacity and the ability to manage risk. During the recent drought in Gujarat, for example, fodder moved to the rural areas whereas in the past people used to migrate to the fodder. The presence of regional markets, government programmes and large-scale co-operatives enabled people in rural Gujarat to obtain access to fodder produced in other areas. As a result, milk production in some areas actually increased, to some extent compensating for the loss of other sources of agricultural income. Income from non-farm activities such as, in the Gujarat case, diamond polishing also depends on regional trade and on the free flow of goods, services, finances and information into and out of rural areas. Systems which enable flows of this type, whether they be remittances from migrants, information regarding markets and weather or access to national financial markets through banks, are central to economic diversification *within* rural areas and thus to the ability of livelihood systems in such areas to adapt to climatic variability.

**Flows of goods, services, finance and information are as important as flows of people in determining adaptive capacity and the ability to manage risk.**



*Climatological measurements provide a scientific basis to understand stock and flow of hydrological processes.*

Adaptation is not only dependent solely on the presence of markets and other systems that enable flows to occur. The

social capital and institutional checks and balances present in rural areas are equally central to adaptive capacity. Unless people have the skills required to identify and take advantage of alternative income opportunities, their ability to adapt is limited. Access to capital and intangible goods like social organisation is key since many activities, however small, require both an initial source of financing and the assistance of others. The need for money and support underlies the critical role of self-help groups (SHGs) and formal institutions. Unless banks are present in rural areas and able to make the types of loans people require, flood- and drought-affected populations are forced to depend on local moneylenders and pay the extortionate rates of interest they charge. Since the formal banking system does not

provide loans to meet basic consumptive needs while travelling in search of work (despite the fact that obtaining access to outside work may be the best investment a family can make) alternatives are needed. Institutions like SHGs provide credit for whatever investments are essential for rebuilding livelihood systems and can create a critical formal check on moneylenders and other informal capital markets. Such institutions along with organisations (such as NGOs, the media and government departments) which provide education and access to information and critical services are central components of the social capital underpinning adaptive capacity. The presence of diverse, competing organisations and sources of information is essential both to ‘keep such organisations honest’ and to

**Skill to identify and take advantage of alternative income opportunities reduces vulnerability.**



Pontoon bridge provides communication link in lower Tarai.



Diverse sources of information are needed.

**Specific factors within livelihood systems can increase or decrease vulnerability.**

provide the diverse array of services required for adaptation to unexpected natural events, climatic variability and other similar types of change.

The presence of key organisations does not, however, imply that all sections of society are able to access them. Patterns of differential vulnerability clearly emerged in all our case study areas. Women and girls in all areas are particularly affected by floods and droughts and in some locations their vulnerability to abuse appeared to increase dramatically. In many cases, the poor also suffered more hardship. Poverty and gender were not, however, the only factors contributing to

vulnerability. In some cases, fairly prosperous groups, such as middle-income farmers, were among the most affected by floods and droughts due to their lack of diversification and, in the drought case, their dependence on unsustainable groundwater sources. As a result, specific structural factors within livelihood systems can increase vulnerability even for those in higher income groups. Overall, however effective society is in catalysing adaptation, actions that address gender and other forms of differential vulnerability are essential if major humanitarian disasters are to be avoided in the context of extreme climatic events.

As the situation above illustrates, natural resource condition and the nature of physical infrastructure can also magnify the risk to livelihood systems and thereby exacerbate the scale of humanitarian disaster. In many regions local hydrological systems have been altered by the overdraft of a regional groundwater aquifer or by the construction of roads, bridges, railway lines, and flood control embankments that fundamentally alter drainage patterns and water availability. These alterations, along with the inherently unpredictable weather patterns that are likely to emerge as a consequence of global climatic change, limit the ability of a society to regulate regional hydrologic systems. Forms of infrastructure that are themselves adapted to hydrologic variability, in contrast, enable social adaptation and thereby minimise vulnerability.

In flood-affected regions, for example, the flat roof of a house enables family members to move belongings out of harm's way and, because they can save household assets, families are able to maintain livelihood systems during flood events. Although the ability to benefit from a flat roof is dependent on the economic status of a family, its utility does not depend on society's ability to predict flow volumes or sediment loads. All that is required for its effective use is a rudimentary knowledge of flood levels and some degree of advance warning. This technology is robust in the context of considerable scientific uncertainty. Similarly, in drought-affected areas families who own cisterns can harvest rainwater and store water purchased on the market. With these and other similar forms of flood- and drought-adapted infrastructure, families can maintain their livelihoods during floods and droughts.

In addition to equitable access to social capital and suitable physical infrastructure, a reliable water supply is essential if communities are to be able to adapt. Unless they have access to clean potable water, households face major health problems and may be forced to migrate. In flooded areas, the nature of water supply systems can make a significant difference. Raised hand-pumps, for example, can supply good quality water for domestic uses even in the midst of contaminated flood waters. Similarly, in drought-affected areas, water harvesting, local water markets or rural water supply systems can

ensure that domestic water supply is available and affordable.

Environmental degradation, particularly of water supply systems, can be an advance indicator of flood and drought vulnerability. Long-term declines in groundwater levels during normal years are, for example, a key advance indicator of vulnerability to drought. Although the timing of a drought may be impossible to predict, the severity of its impact depends heavily on the ability of a local population to access groundwater. In areas where water levels are declining rapidly and regional hydro-geological conditions (such as the presence of hard rock or saline zones underlying productive aquifers) mean that water is available only to a limited depth, and communities will be highly vulnerable to drought. Areas where development activities have included the construction of structures that impede drainage are likely to be vulnerable to floods. Overall, as has been widely recognised in a variety of situations around the world, environmental conditions are central to determining the degree of disaster vulnerability.<sup>1</sup>

In addition to core results described above, our fieldwork highlighted five other key points:

*First*, because the ability of populations to adapt to floods, droughts and climatic variability is heavily influenced by the degree to which people, finance, goods, services and information can move across local and national borders, the factors governing

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**Long-term declines in groundwater levels during normal years are a key advance indicator of vulnerability to drought.**

these flows are a critical area for policy research both within countries and at the global level. If global climatic change occurs abruptly, as some predict it may, the importance of migration and local to global flows of information, finance, goods and services to local adaptive capacities – and, indeed, to the very survival of local populations – raises critical humanitarian issues that extend beyond the provision of relief. How such issues are addressed may, in many cases, depend on global perspectives toward migration and the array of global institutions that moderate trade, information and financial flows. The critical issue is not food availability *per se* but the ability to maintain livelihoods, earn the cash required to purchase food and ensure that food and other basic necessities are able to flow to flood- or drought-affected populations.

*Second*, at present there is little information available to actors and decision-makers on the changing dimensions of vulnerability or on the effectiveness of systemic approaches to vulnerability reduction. Most disaster relief efforts assume that the poor and landless are the most vulnerable. As some of our case results illustrate, however, vulnerability depends on specific livelihood characteristics. The poor, who often have more experience with labour markets, may, in some

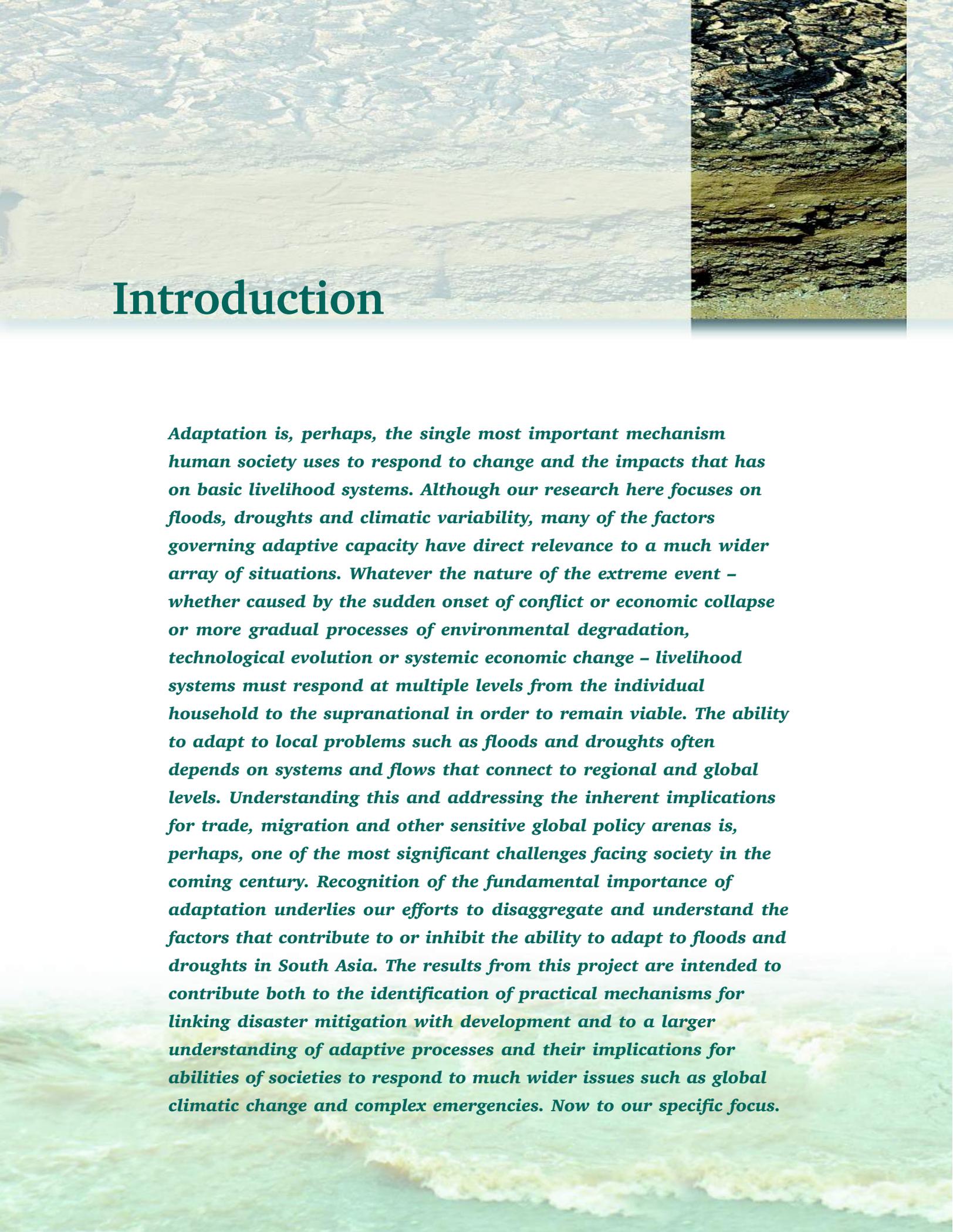
cases, be less vulnerable than other populations which are less experienced and lack the skills required for changing livelihoods. Overall, there is a need for better understanding of the factors that enable adaptation.

*Third*, it is essential to improve our understanding of the humanitarian implications of floods, droughts and changing patterns of climatic variability. Our field results indicate that basic humanitarian concerns such as violence against women and girls and the immiseration of vulnerable populations must be dealt with.

*Fourth*, given the dependence of adaptive capacity on migration, commuting and access to non-farm livelihoods, the importance of issues related to urbanisation and the quality of life in urban areas will increase.

*Fifth*, and finally, programmes such as India’s work on watershed development in drought-prone areas may represent an initial tangible mechanism for linking development with disaster mitigation. Such programmes are not present in flood-prone areas. The potential for expanding watershed programmes and others like it and shifting their focus to include many of the factors central to adaptation should be explored.

**Local to global flows of information, finances, goods and services influence local adaptive capacities.**



# Introduction

*Adaptation is, perhaps, the single most important mechanism human society uses to respond to change and the impacts that has on basic livelihood systems. Although our research here focuses on floods, droughts and climatic variability, many of the factors governing adaptive capacity have direct relevance to a much wider array of situations. Whatever the nature of the extreme event – whether caused by the sudden onset of conflict or economic collapse or more gradual processes of environmental degradation, technological evolution or systemic economic change – livelihood systems must respond at multiple levels from the individual household to the supranational in order to remain viable. The ability to adapt to local problems such as floods and droughts often depends on systems and flows that connect to regional and global levels. Understanding this and addressing the inherent implications for trade, migration and other sensitive global policy arenas is, perhaps, one of the most significant challenges facing society in the coming century. Recognition of the fundamental importance of adaptation underlies our efforts to disaggregate and understand the factors that contribute to or inhibit the ability to adapt to floods and droughts in South Asia. The results from this project are intended to contribute both to the identification of practical mechanisms for linking disaster mitigation with development and to a larger understanding of adaptive processes and their implications for abilities of societies to respond to much wider issues such as global climatic change and complex emergencies. Now to our specific focus.*

Floods and droughts are among the most important natural factors affecting rural livelihoods in South Asia. Unlike the temperate zones of Europe and North America, the climatic regimes of South Asia are, by definition, intemperate or extreme. In Bihar, for example, officially published data indicate that flood-related damage increased from 9.49 million rupees in 1989-1990 to 5,147.8 million rupees in 1998-1999. In Uttar Pradesh, the floods of 1998 destroyed 80,000 homes and caused approximately 1,500 deaths across 55 districts. Every year approximately 80,000 people living adjacent to the Kosi River migrate to Punjab and Haryana during the flood season.<sup>1</sup> In other parts of India, droughts have a similarly devastating impact. Approximately 33% of India's arable area (about 14% of the total land area) is drought-prone. In such

areas droughts are a frequent and inherent feature of life. Another 35% of India's area can also be affected by drought when rainfall is exceptionally low for extended periods. In 2003, over 40 million people in 40,990 villages were affected by drought in Rajasthan alone. According to UN Disaster Management Team Situation Reports, this drought, the culmination of four years of below average precipitation, forced a reduction in cropped area by over 30% and resulted in production losses of approximately 50%.<sup>2</sup> To meet survival needs, many families reduced food consumption and withdrew children from school to work as wage labourers or in other occupations.<sup>3</sup> The search for drinking water had a particularly adverse impact on women who were often forced to walk many kilometres to meet the daily needs of their families. Similar impacts occurred in Gujarat. The drought of 2000, for instance, had a major impact on drinking water supplies for 25 million people in 9,500 villages, 79 towns and four major metropolitan areas.<sup>4</sup> The hardship increased as the drought continued over subsequent years. By the summer of 2003, some villages, particularly those overlying areas where groundwater levels have been declining for decades, experienced dramatic decreases in agricultural production. This had a major impact on income levels and forced fundamental changes in livelihoods.<sup>5</sup>

**While droughts and floods are an inherent feature of life in South Asia, they have been greatly exacerbated by human interventions that have changed both hydrologic systems and the impacts associated with extreme events.**



*New technologies improve efficiency but can debilitate traditional methods as well as the resource base itself.*

While droughts and floods are an inherent feature of life in South Asia, they have been greatly exacerbated by human interventions that have changed

both hydrologic systems and the impacts associated with extreme events. Groundwater overdraft in arid regions and the construction of roads, embankments and other structures in flood-prone zones have fundamentally altered the hydrologic characteristics of many regions. In drought-prone areas, groundwater level declines have, as projected over a decade ago,<sup>6</sup> reduced the ability of the society to draw upon buffer supplies when drought occurs. At the same time, agricultural intensification using green revolution technologies has increased the dependence of agricultural systems on the reliability of a regular supply of water. As a result, droughts have a fundamental impact on the economic viability of rural livelihood systems. Similarly catastrophic impacts occur in the case of floods. Drainage congestion is, for example, now widely recognised as a major factor compounding the extent and duration of flooding in much of the Ganga basin.<sup>7</sup> In addition, greater investments in seeds, fertilizers and other agricultural production inputs have increased the potential for losses when flooding occurs. Despite the highly variable but relatively consistent levels of flooding over the last half century (Figures 1 and 2), the economic and social impact of floods have increased. Losses per hectare during the last Five-Year Plan for which data are available (1992-1997) are more than 50% higher than the levels common in the first and second Five-Year Plans (1951-1961) despite being substantially less than the levels common in the 1980s.<sup>8</sup>

Figure 1: Flood-Affected Area in India

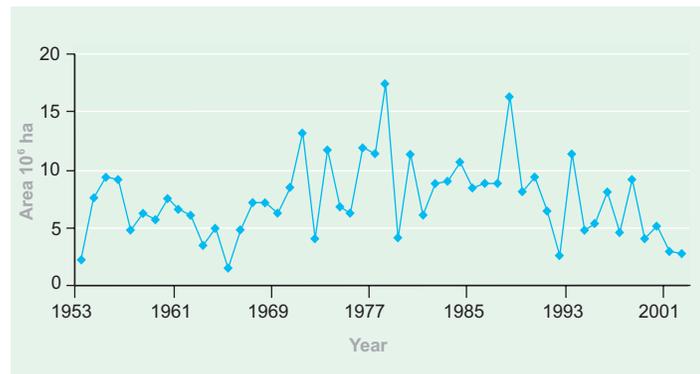
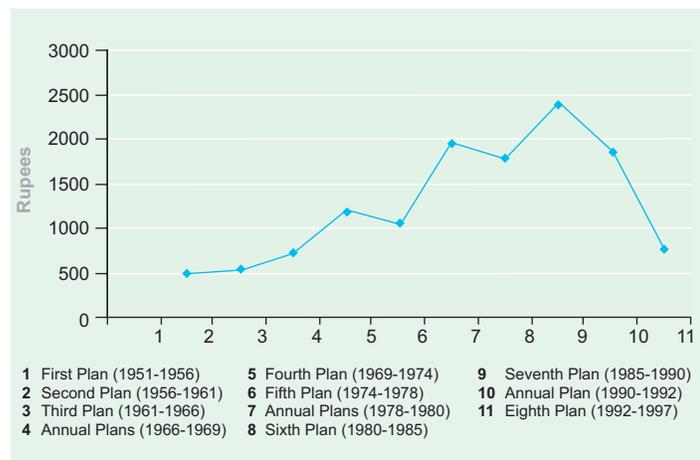


Figure 2: Impact of Flooding: Financial Losses per Hectare in India



The fact that losses due to flooding have increased is recognised by the government of India. As the Planning Commission notes in the chapter on flood management in the Tenth Five-Year Plan,<sup>9</sup> flood damage in India during the first three years of the Ninth Five-Year Plan exceeded allocations substantially and is related to the increasing amount of economic activity in flood plains. The willingness of local, state and national government entities to act on this recognition by addressing vulnerable forms of development is, however, limited. The Planning Commission, for example,

**Groundwater overdraft in arid regions and the construction of roads, embankments and other structures in flood-prone zones have fundamentally altered the hydrologic characteristics of many regions.**

notes a ‘hesitation’ on the part of state governments to enact flood plain zoning legislation and argues for ‘other immediate steps such as differential insurance rules, additional surcharge by way of property tax on structures in risk areas, etc.’ They go on to advocate permanent solutions based on ‘the construction of storage, raising of villages, modification in cropping pattern (sowing crops which can tolerate waterlogging) and setting up of a nation-wide network of communication, forecasting and forewarning systems’.<sup>10</sup>

**South Asia is, in many regions, changing from a rural society to one that could, perhaps, be described as peri-urban.**

Overall, the root causes of vulnerability are related to human-induced changes in hydrologic systems, greater economic activity in vulnerable regions and patterns of development that are poorly adapted to the inherent variability of natural systems. All three factors increase the level of risk for livelihood systems. This situation and the responses proposed by governments are embedded in a much wider context of social and economic change. South Asia is, in many regions, changing from a rural society to one that could, perhaps, be described as peri-urban. Rural regions are increasingly well connected to urban areas through transportation, communication, market and labour networks. Villages are transforming into towns and towns into small- and medium-sized cities. Commuting, migration and non-agricultural economic activities increasingly represent important, if not dominant, components in the livelihood portfolios of rural farm households. This process, however, is nothing new.

The role of urban-rural interlinkages was recognised as a central feature in the rural livelihoods of Nepal over a decade ago.<sup>11</sup> More broadly, the *desakota* (a word derived from the Indonesian words for ‘country’ and ‘town’) model of urban-rural symbiosis for regions of space-economy transition<sup>12</sup> is being increasingly applied as a framework for understanding widespread patterns of socio-economic transition in Asia and many other parts of the world that combine features conventionally associated with either rural or urban regions. Instead of black-and-white urban versus rural distinctions, emerging patterns reflect a broad spectrum of situations that range from truly urban cores through many shades of grey to areas that, perhaps, remain truly rural. Urban and rural regions form part of a continuum rather than being dichotomous end points.

Preliminary results from the Adaptive Strategies Project indicate that vulnerability and the social impacts associated with floods and droughts are heavily influenced by the context described above. Field surveys conducted under the project provide a broad outline of flood and drought response patterns at local levels. Results indicate that vulnerability and the social impacts associated with floods, droughts and climatic variability are heavily influenced by at least eight factors:

1. The nature of livelihood systems within a region, in particular the extent to which individuals and households are able to diversify

income strategies and incorporate non-farm components, many of which are less vulnerable to disruption from natural disasters than agriculture is;

2. The ability of people to migrate or commute in order to obtain access to non-farm or agricultural sources of income outside of drought and flood-affected areas;
3. The ability of information, goods and services to flow into and out of affected areas;
4. The differential social capital and institutional checks and balances that households have access to, including education, community institutions such as self-help groups, formal institutions such as government departments and banks, non-government organisations, the media and social networks;
5. Existing patterns of differential vulnerability created by gender, income and social position;
6. The nature of physical infrastructure (roads, houses, water supply systems, etc.) in particular:
  - a. the degree to which such infrastructure is vulnerable to being disrupted by floods and droughts; and
  - b. the extent to which such infrastructure allows the maintenance of livelihoods during drought and flood periods by serving as a point of

refuge, helping to protect assets and facilitating the movement of goods, services and people;

7. The ability of households to obtain secure sources of water for domestic uses (whether such water supply security is developed through local sources, long-distance transport through water markets or rural supply schemes);
8. Natural resource conditions, particularly the degree to which ground and surface water systems are disrupted. Specific indicators include:
  - a. long-term declines in water level as a major warning signal of the increasing vulnerability to droughts of irrigated agricultural systems;
  - b. the increased presence of structures (such as roads, bridges, embankments for railways and flood control) that interfere with the existing patterns of natural drainage as an indicator of the greater likelihood of flooding.

It is important to recognise that the ability of a population to adapt to or cope with floods, droughts and climatic variability depends heavily on a variety of factors that cross local, regional and national boundaries. Stable agricultural livelihoods in drought- and flood-prone regions often depend on the presence of multiple income sources – often including remittances sent by long- or short-term migrants – for use as capital

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**The ability of a population to adapt to or cope with floods, droughts and climatic variability depends heavily on a variety of factors that cross local, regional and national boundaries.**

investment and to tide over the declines in income associated with drought and flood events in South Asia. Migration and commuting are, as a result, essential activities on which the viability of rural livelihoods depend. Similar findings are common in locations as diverse as Afghanistan and Africa.<sup>13</sup> This is not to say that all migration is good or desirable. Displacement in the context of a drought, flood or other disaster often leads to impoverishment. Recognition of the role migration plays in maintaining rural populations is, however, essential. The flow of people across rural and urban boundaries, districts, states and national borders can provide access to much more diverse livelihood opportunities than are present in many rural areas. Similarly, flows of information, goods, services and economic activity into and out of rural areas enable local populations to obtain access to key resources –

fodder, food, jobs and advance warning – when drought or floods disrupt local systems. All such flows are fundamentally important in determining the ability of populations to adapt to local climatic variations. Furthermore, as with water in a trans-boundary river, all of them have major trans-boundary implications for policy and practice.

Detailed information from our case studies is presented below in order to substantiate the above conclusions and explore their implications for development and disaster mitigation strategies. Before moving onto the details, however, it is important to provide a clear understanding of the purpose and objectives underlying this study and a definition of adaptive strategies as well as to discuss the conceptual foundations on which such strategies rest and the difference between adaptive approaches and conventional strategies.

**Flows of information, goods, services and economic activity into and out of rural areas enable local populations to obtain access to key resources – fodder, food, jobs and advance warning – when drought or floods disrupt local systems.**

## PURPOSE AND OBJECTIVES

To be effective, approaches to addressing both long-term water management needs and the impacts of extreme events must reflect the context in which they are embedded. At present, most water management strategies focus primarily on hydrologic and water use systems *per se* and pay relatively little attention to the changing context in which these systems are entrenched and from which

they spring. Similarly, most attempts to respond to drought and flood events focus heavily on immediate relief and ignore opportunities to change long-term factors underlying different patterns of vulnerability.

The purpose of this project is to develop a broad-based understanding of the impacts floods, droughts and long-term water problems have on livelihoods

and how such impacts are influenced by the changing socio-economic and demographic context of rural South Asia. We seek to improve understanding of the incentives facing populations within the region, the opportunities they perceive and the constraints within which they must work as they respond to the immediate impacts of floods and droughts and the long-term effects of emerging water-related problems like groundwater overdraft. We also seek to improve our understanding of the implications such incentives, opportunities and constraints have for disaster mitigation and long-term development strategies.

The specific objective of this project is to identify points of leverage where investing resources in development support and disaster mitigation could assist communities in adapting to changing water realities<sup>14</sup> and, where possible, to improve options for the management of the water resource base. Philosophically, the project is founded on the belief that many water management and disaster mitigation initiatives have limited impact because they poorly reflect the aspirations and incentives local communities have and the wider processes of economic, demographic and social change in which local communities are embedded. Strategies that are adaptive, i.e. that identify and build on key contextual elements are, we believe, far more likely to be successful. In addition, much research on local water management challenges have emphasised the highly variable nature of water problems and the episodic

nature of change in response to them.<sup>15</sup> Floods and droughts affect different regions in different ways. They are times of crisis but also times of change and opportunity. As one review following the Orissa cyclone of 1999 commented: ‘In many ways a disaster situation reduces the rigidity of a social system, and of transforming structures and processes. This provides opportunities for both understanding the systems in ways that are not normally available, and for changing the systems.’<sup>16</sup> Effective strategies for responding to long-term water problems and reducing vulnerability should, in themselves, be adaptive. That is to say, they should be capable of responding to changing conditions and to windows of opportunity while also addressing the inherent variability in local conditions. The larger objective of this project is to begin the process of outlining adaptive strategies that can help to bring together long-term development and vulnerability reduction. The end result will, we hope, be forms of development support that contribute substantively to the resilience of livelihoods in regions where droughts and floods are endemic.

The structure underlying our approach is similar to the logical structure developed over the last decade by *Duryog Nivaran*, the network of individuals and organisations advocating alternative approaches to disaster mitigation. This logical structure holds that:

1. Extreme climatic events induce stresses and often irreversible changes in both natural and

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**Adaptive strategies**  
weave together long-term development and vulnerability reduction.

- social systems;
- 2. In the aftermath of such events, both systems begin the process of adaptation to new realities;
- 3. Unfortunately, most conventional disaster relief is geared to restoring the *status quo ante*, a state neither nature nor society is willing to (or capable of) returning to;
- 4. As a result, it is better to use

- resources to help people and places to adapt to the new context rather than attempting to return to pre-existing conditions;
- 5. In a larger sense, disasters, can be seen as opportunities for development to be the way it really should be. Disasters it is argued, are the unfinished business of development.

## METHODOLOGY

The project on adaptive strategies for responding to droughts and floods was designed as a collaborative effort involving partners from both India and Nepal. Although academic research capacities were a consideration in developing the partnership, our approach emphasised the involvement of partners having an established presence and a solid track record of providing development support to local populations in flood- and drought-affected areas across South Asia. This approach was central to the project for three reasons:

- 1. The identification and analysis of adaptive processes in households and communities require in-depth familiarity with the livelihood systems, the patterns of change and the nuances of life at a local level. Unless partner organisations are solidly rooted in the areas where data collection and analysis are occurring, they are unlikely to be able to communicate sensitively and effectively with the involved

communities. An established, long-term presence in the affected areas was central to understanding many of the processes of greatest relevance for the project.

- 2. We did not want the project to become too ‘academic.’ Although it is essential for all results to grow from solid conceptual and analytical foundations, it is equally essential for them to lead toward implementation. Furthermore, we believe that the process of analysis itself should contribute to the development of local capacity and strengthen the ability of local organisations to fulfil their own, already established missions.
- 3. We believe it is important for the results of the project to strengthen collaborative relationships both within countries and across borders. Floods, droughts and climatic variability are *regional* phenomena which have *global* as well as *local* implications. Unless

**Floods and droughts are times of crisis but also times of change and opportunity.**

insights cross borders and partnerships are established, responses remain fragmentary and partial. The establishment of new forms of regional and global collaboration is as important to the project as the generation of any specific analytical results.

To meet the goal described above, the project was designed as a layered initiative with local, regional and global partners each playing major roles. Core components included:

- A major global initiative to derive lessons from decades of research on disaster management, livelihoods, processes of social change and adaptive dynamics in complex systems;
- Regional studies on drought and flood mitigation policies and on the implications of climate change for extreme climatic events in South Asia;
- A series of field case studies in flood-affected portions of Nepal, Uttar Pradesh and Bihar complemented by parallel case studies in drought-prone areas in Gujarat and Rajasthan.

The overall conceptual framework and the survey instruments for the case studies were jointly developed by the full group of collaborating partners through a series of methodology workshops that integrated conceptual insights and methods from the global scientific community with the field experience of local organisations. Case studies were then undertaken by local NGOs or by research organisations using their own established field staff deriving support from regional and global expertise. These case studies were coordinated within the full research group but some of the details of surveys and elements of approach were modified by local organisations to reflect conditions in their field areas.

In framing the case study and regional approaches to data collection and analysis, substantial effort was devoted to defining what we mean by ‘adaptive strategies’. This was an essential first step in order to ensure all involved organisations shared a common understanding of the questions the project intended to address. As it was for the study itself, clarifying the meaning we attach to the concept of adaptation is central to this report.

**The overall conceptual framework and survey instruments for the case studies were jointly developed by the full group of collaborating partners.**

## End Notes

<sup>1</sup> Chaturvedi and Saroch (2004)

<sup>2</sup> Wilbur Smith Associates (2003)

<sup>3</sup> Sivakumar and Kerbart (2004)

<sup>4</sup> VIKSAT, personal communication citing Gujarat Jal Disha (2000)

<sup>5</sup> VIKSAT – field report notes, 2004.

<sup>6</sup> Moench (1992)

<sup>7</sup> Mishra (1997); D’Souza (1999); Gyawali (2001) and Dixit, (2002)

<sup>8</sup> Data from Government of India cited in Chaturvedi, S. and E. Saroch (2004). ‘Managing’ in India: Realities, Perceptions and Policies. Boulder, Institute for Social and Environmental Transition: 54.

<sup>9</sup> Government of India (2001)

<sup>10</sup> *Ibid.*

<sup>11</sup> Gyawali, Schwank *et al.* (1993)

<sup>12</sup> McGee (1991)

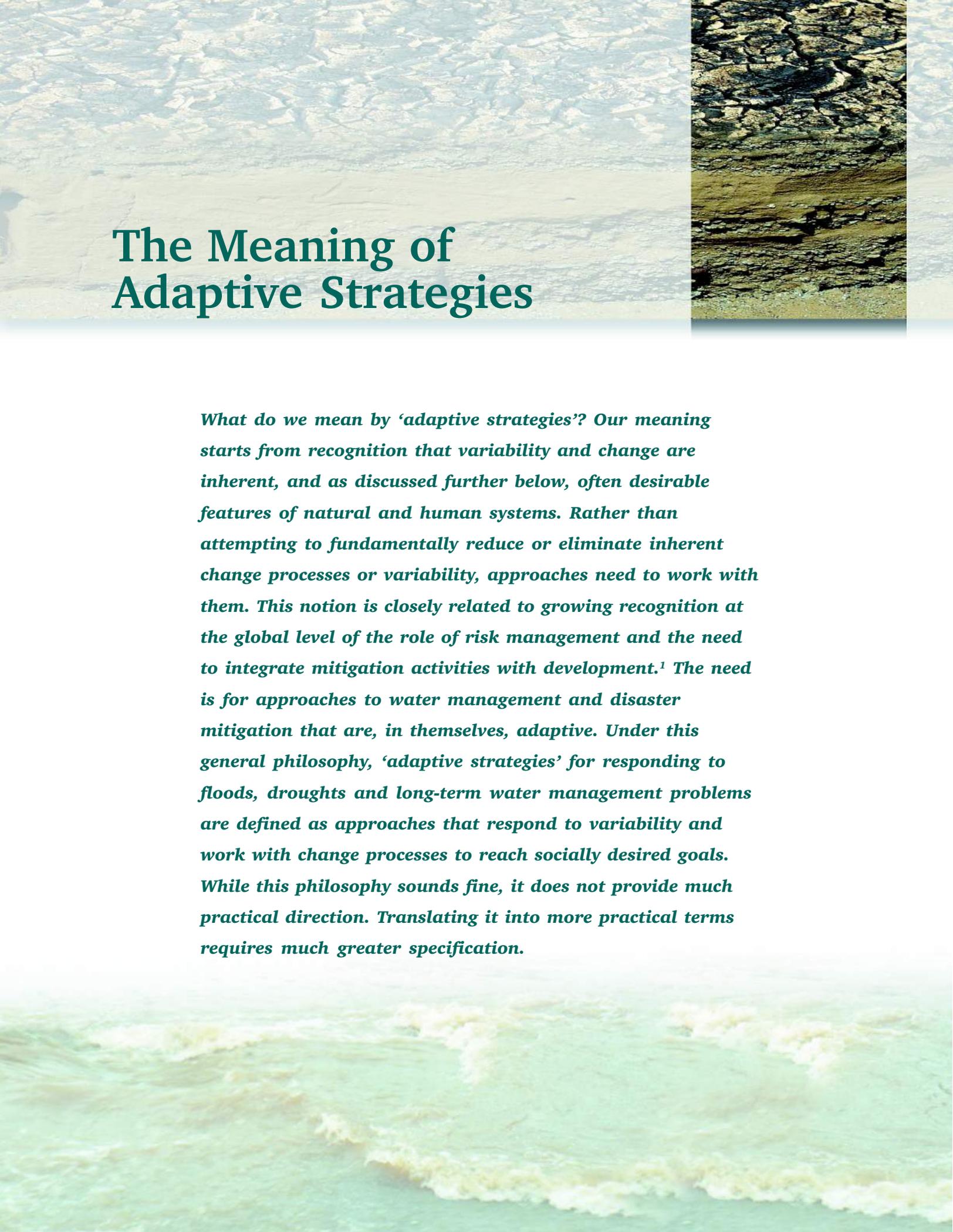
<sup>13</sup> Benson and Clay (2002); Lautze, Stites *et al.* (2002); Pratt (2002); Lautze, Aklilu *et al.* (2003)

<sup>14</sup> Water reality is thought of in physical, institutional, political and entitlement terms. The physical realities are factors such as groundwater overdraft that cannot be reversed overnight or changed drainage patterns. The institutional realities are related with water use and demography built around them, e.g. Gujarat’s groundwater dependent agriculture cannot go back to being totally rain-fed. The political factors are related with scale, e.g. one cannot register 30 million wells after they become operational. Lastly, the entitlement factor is related to water service that people aspire, e.g. urban residents expect flush toilets and running water in taps.

<sup>15</sup> Moench (2003); Moench, Dixit *et al.* (2003)

<sup>16</sup> IMM Ltd. (2001)





# The Meaning of Adaptive Strategies

*What do we mean by ‘adaptive strategies’? Our meaning starts from recognition that variability and change are inherent, and as discussed further below, often desirable features of natural and human systems. Rather than attempting to fundamentally reduce or eliminate inherent change processes or variability, approaches need to work with them. This notion is closely related to growing recognition at the global level of the role of risk management and the need to integrate mitigation activities with development.<sup>1</sup> The need is for approaches to water management and disaster mitigation that are, in themselves, adaptive. Under this general philosophy, ‘adaptive strategies’ for responding to floods, droughts and long-term water management problems are defined as approaches that respond to variability and work with change processes to reach socially desired goals. While this philosophy sounds fine, it does not provide much practical direction. Translating it into more practical terms requires much greater specification.*

## KEY ELEMENTS IN OUR DEFINITION

What do we mean by approaches to drought and flood mitigation and water development that are ‘adaptive’? Core elements in our definition include strategies that:

- focus on the development of physical infrastructure that is adapted to (works with rather than attempts to control) the natural cycle of drought, flooding and other extreme climatic events in a given region;
- increase the resilience of economic and livelihood systems, spread risks and strengthen the ability of individuals, households and communities to adjust economically to extreme events and long-term changes in the water context;
- build off existing patterns of adaptation, i.e. what people are already doing, the perspectives they bring to drought and flood problems, and the opportunities they see for reducing vulnerability;
- are, themselves, adaptive (i.e. have in-built processes to respond to variability, to adjust as conditions

change and to build the capacity to learn);

- recognise and attempt to take advantage of the windows of opportunity for change created by floods, droughts and other fluctuations in water resources or other conditions; and
- reflect the incentives inherent in hierarchically structured organisations, the individualistic competition in the market and the more egalitarian focus of many social service entities and utilise the differing capacities each of these forms of organising brings to mitigate the impacts of droughts and floods.

Taken together the above elements imply a definition that, rather than attempting spurious precision, recognises the value of elegantly clumsy strategies. Such strategies are opportunistic, able to respond to contexts and draw on the mix of market, private sector, government and community and civic institutions which are the constituents of human society at all levels.

**Adaptive strategies for responding to floods, and drought and long-term water management problems are defined as approaches that respond to variability and work with change processes to reach socially desired goals.**

## CONCEPTUAL FOUNDATIONS OF ADAPTIVE CAPACITY AND LIVELIHOOD RESILIENCE

The conceptual foundations underlying the development of adaptive approaches for responding to droughts, floods and long-term water management problems grow out of the

expanding field of research on risk and the dynamics of ecological and social systems. This research provides deep insights into the concepts of resilience and adaptation and into the factors

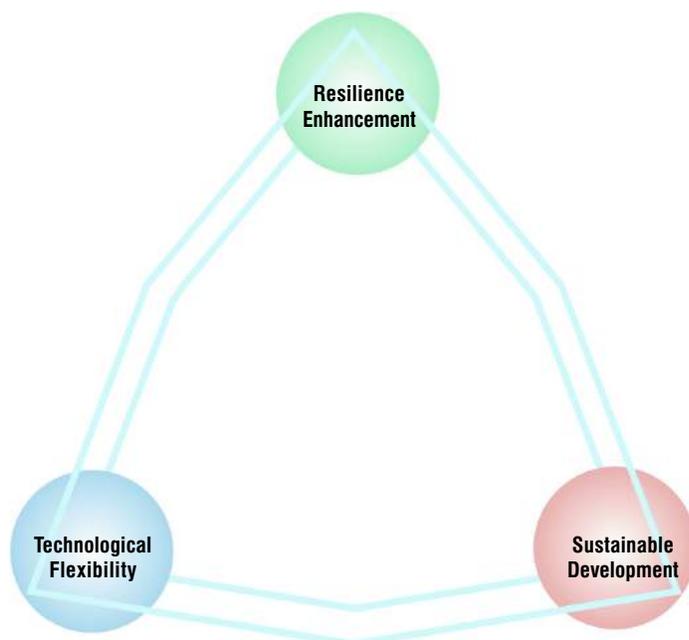
that contribute to their presence within complex systems. Before exploring the nature of resilience and adaptation, however, it is important to emphasise one element many studies of system dynamics lack: the concept of agency. Unlike most natural system components, humans are proactive and strategising agents of change. Agency, the ability to evaluate situations and act strategically gives humans the potential ability to direct patterns of adaptation in ways that increase the resilience of livelihood systems. Now to the question of adaptation and resilience: the Resilience Project, a collaboration of many individuals and organisations jointly contributing to the development of new conceptual insights on system dynamics, defines ecosystem resilience as:

“the capacity of an ecosystem to tolerate disturbance without collapsing into a qualitatively different state that is controlled by a

different set of processes. A resilient ecosystem can withstand shocks and rebuild itself when necessary. Resilience in social systems has the added capacity of humans to anticipate and plan for the future. Humans are part of the natural world. We depend on ecological systems for our survival and we continuously impact the ecosystems in which we live from the local to global scale. Resilience is a property of these linked social-ecological systems (SES). ‘Resilience’ as applied to ecosystems, or to integrated systems of people and the natural environment, has three defining characteristics:

1. The amount of change the system can undergo and still retain the same controls on function and structure
2. The degree to which the system is capable of self-organisation
3. The ability to build and increase the capacity for learning and adaptation.”<sup>2</sup>

**The ability to adapt to local problems such as floods and droughts often depends on systems and flows that connect to regional and global levels. Understanding this and addressing the inherent implications for trade, migration and other sensitive global policy arenas is, perhaps, one of the most significant challenges facing society in the coming century.**



The concept of resilience enhancement is also dependent on technological flexibility and sustainable development. Based on Thompson (1994)

All of the above points are important. Understanding the amount of change a system can undergo while still retaining its core functions and structure requires a combination of both social and natural science as well as a solid capacity to analyse system dynamics. To understand vulnerability we need to understand systems. Self-organisation is equally important. Resilient livelihoods are those that can first recover (self-organise) after disruption and following recovery are capable of learning and adapting; they have a strong ability to cope with surprises and change as conditions require.<sup>3</sup> This highlights the third point: that adaptive capacity is itself essential for resilience.

Much conventional development has eroded the capacity of communities to self-organise, even to the extent of robbing them of self-respect. Farmers, for example, lack the capacity to replace a cement concrete dam when a flash flood washes it away, but they are often able to replace structures that rely on locally available skills and resources. Reliance on the cement concrete dam, as a result, not only reduces the ability to self-organise when failure occurs but also induces dependency on higher level organisations. The outcome is resilience depletion.<sup>4</sup>

Studies on system dynamics, indeed, the above example of the dam, indicate that resilience and the ability to adapt are themselves dependent on disruption. High levels of stability are, in fact, often undesirable. In

ecosystems, increasing stability is strongly associated with increasing rigidity. As uncertainty and variability decline, systems become increasingly structured and, as long as conditions remain routine, efficient. Such systems are much more vulnerable to catastrophic failure when key parameters are exceeded than systems where inherent variability necessitates the maintenance of diverse (but less efficient) functional sources of support.<sup>5</sup> To put this another way, the ability to manage risk depends on the continued presence and experience of risk factors. When people are not exposed to risk on a regular basis, their ability to respond to surprise declines. Concrete dams may be more efficient than locally constructed brushwood dams but, because they require little routine re-building, local communities often do not have the capacity to repair them. Capacity is only maintained where it is in constant use. As Gunderson and Holling state: 'Variability in ecosystems is not merely an inconvenient characteristic of these productive, dynamic systems. It is essential for their maintenance'.<sup>6</sup>

What does this mean in the immediate context of floods and droughts in South Asia? The case of groundwater irrigated agriculture provides a clear illustration. Over the past five decades, increasing access to groundwater has been a major factor in increasing the reliability of agricultural production and reducing poverty in rural communities across South Asia.<sup>7</sup> Groundwater irrigated areas generally are more productive and generate more

**The conceptual foundations underlying the development of adaptive approaches for responding to droughts, floods and long-term water management problems grow out of the expanding field of research on risk and the dynamics of ecological and social systems.**

income than areas irrigated using other sources.<sup>8</sup> Use of groundwater also reduces the immediate risk of loss.<sup>9</sup> These factors enable farmers to invest in fertilizers and other inputs and, consequently, to generate surpluses far more consistently than when they depend on rainfall or surface irrigation. Reliance on groundwater has fundamentally reduced the variability rural communities must cope with and allowed the spread of agricultural systems focused on the production of a narrow range of market crops. While this has had major economic benefits, it has also encouraged the development of much more rigid agricultural economic systems. Green revolution technologies utilise a relatively narrow range of crop varieties, all of which depend on assured water supplies. When inputs become unavailable or variety-specific diseases spread, the systems are susceptible to sudden collapse. In many agricultural areas, groundwater has served as the primary buffer against natural climatic variability and recurrent drought. As a result, when wells dry up suddenly due to a combination of long-term groundwater overdraft and drought (a situation which was common in rural Rajasthan and Gujarat during the drought period of 1999-2003), rigid livelihood systems that depend primarily on intensive agricultural production are forced to adapt suddenly and painfully. This situation is clearly illustrated later in this report in the case study on Satlasana, Gujarat.

Similar situations exist in many attempts to reduce the impact of floods, droughts and other natural disasters. Where flood and drought mitigation activities reduce the need for rural inhabitants to develop livelihood systems capable of responding to normal variability, livelihood systems become much more vulnerable to disruption when they are actually subject to major flood or drought impacts. If a family only needs to access a boat once every ten years when major levee (embankment) breaches occur, the boat is much less likely to be available and well maintained than if the same boat is required several times every year. The same dynamics apply to social networks and the diversity of livelihood strategies. Overall, attempts to reduce variability and increase security often have the unintended consequence of reducing the ability of livelihood systems to cope with or adapt to major changes in fundamental system parameters.

Beyond exposure to variability, studies of social and ecosystem dynamics provide clear conceptual insights into the factors that contribute to enhance resilience and adaptive capacity. In systems ecology, diversity and the presence of multiple pathways for energy and information flow are widely recognised as central to resilience and adaptive capacity. The ability to buffer energy stores is also central to the survival of plant and animal species in periods of low production, whether they involve predictable seasonal

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**with surprises and change as**  
**conditions require.**

variations or less predictable fluctuations. Furthermore, generalist species, those that are able to fill many ecological niches, are often much less vulnerable to disruption than specialist forms that have evolved to fit narrowly defined niches.

Where livelihoods are concerned, the above insights from systems ecology suggest that the following factors are fundamentally important to resilience and adaptive capacity:

- Access to diverse, independent income sources and income strategies;
- The general educational and other skills required to respond to constraints and take advantage of diverse income niches as opportunities emerge;

- Support systems (information, social networks, community organisations, markets, etc.) that allow people to migrate (or commute) and information and resources to flow through diverse channels and often across national and state boundaries when surprises occur or conditions change; and
- The presence of capital reserves and assets.

**Studies on system dynamics indicate that resilience and the ability to adapt are themselves dependent on disruption. High levels of stability are, in fact, often undesirable.**

Vulnerable populations typically do not score well on evaluations of the above factors. The poor, for example, are often dependent on a very narrow set of income opportunities, such as agricultural wage labour. They lack the knowledge, education and other skills necessary to take advantage of new opportunities created by expanding or



*Drought conditions are also a function of climate.*

changing economies. They are also often physically isolated and lack the transport, communications and other infrastructure necessary to allow goods to flow to them and to enable their own assets (whether products or labour) to flow out and access wider economic opportunities. Where institutions are concerned, they generally lack access to formal organisations, such as banks, that provide support and may have weak social networks. Finally, by definition they lack substantial capital reserves or other assets. As a result, poor populations often lack the capacity to adapt when support systems experience even minor disruptions. Instead of developing adaptive livelihood systems that derive their resilient nature from the constant pressures and opportunities created by variability, the poor often experience such variability as ‘waves of adversity’.<sup>10</sup> Each disruption or wave of adversity depletes the capital reserves needed both to build adaptive capacity and to buffer future disruptions.

The above said, it is important to recognise that poverty is not the only, or, indeed, necessarily the primary, factor contributing to vulnerability. Many middle-income groups have become vulnerable by specialising. Middle-income farmers, for example, often practice extremely intensive forms of agriculture that depend heavily on access to regular water supplies and on a narrow range of crop varieties. While such systems can improve living standards, middle-income groups are often unable to accumulate substantial

capital reserves. Because their livelihoods are somewhat buffered from normal fluctuations through access to resources such as groundwater, they often lack the incentives to invest in education and other forms of diversification. Furthermore, because they do not have to cope with serious fluctuations in income on a regular basis, they are often unfamiliar with labour markets and migrating to obtain work during periods of crisis. As a result, they can be even more vulnerable than the poor or other marginal communities when serious disruptions occur. Specialisation, while it can underpin highly productive income streams, is in itself an indicator of vulnerability if the factors on which that specialty depends are disrupted.

On a conceptual level, therefore, strategies for both long-term development and disaster relief need to enable populations to accumulate buffering resources but not remove the pressure created by variability to diversify and adapt. Furthermore, as a final theoretical note, it is important to recognise that the concepts of adaptive capacity and resilient livelihoods are layered. Resilience at the level of household livelihoods depends on the presence of larger systems (markets, information flow, political systems, etc.) that enable flows of information, materials and people at regional, national and global levels. This parallels the argument by Dreze and Sen that the impact of a natural disaster is closely related to its

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**Attempts to reduce variability and increase security often have the unintended consequence of reducing the ability of livelihood systems to cope with or adapt to major changes in fundamental system parameters.**

political context. As they stated in 1989:

“In countries with relatively pluralistic political systems, open channels of protest have also helped to direct forcefully the attention of the authorities to the need for preventive action without delay’.<sup>11</sup> It is, we have argued, no accident that the countries that have been most successful in famine prevention in the recent past have typically had rather pluralistic politics with open channels of communication and criticism. A relatively free newspaper system may be the most effective ‘early warning’ system a famine-prone country can rely on.”<sup>12</sup>

**It is important to recognise that poverty is not the only, or, indeed, necessarily the primary, factor contributing to vulnerability.**

Where political systems encourage the flow of information and protest, governments and other institutions that face or learn about crises are forced to respond. As Drez and Sen further argue; ‘the accountability of the Indian government to the electorate (combined with a relatively free press) has made the prevention of famines a political compulsion’.<sup>13</sup> Their point is directly parallel to our own argument about the critical role played by social auditors in water and other natural resource governance.<sup>14</sup> An alert civil society that uses the media as a forum and has the scientific and other capacities needed for investigating and raising early warning signals about impending problems is central to effective governance and the resilience of political and economic systems. It is not however, just information and political accountability that increase resilience. Where regional economies are narrowly based and the diversity of economic opportunities open to populations within them limited, vulnerability to disruption at all levels in the system is higher. Similarly, where policies discourage migration or attempt to return populations to the conditions existing prior to droughts or floods, the incentive and consequently the long-term ability to adapt is reduced. The development of resilient livelihoods requires strategies that recognise and build upon the incentives for change created by disruptions such as droughts and floods rather than viewing such disruptions as aberrations to which the appropriate response is an attempt to rebuild the *status quo*.



Local scientific capacity helps to better understand natural variability.

## CONTRASTS WITH CONVENTIONAL APPROACHES

The difference between conventional approaches to disaster mitigation and the perspectives we bring to the interlinked issues of disaster and development are summarised in the table below, which has been adapted, with some modifications, from *Duryog Nivaran*.<sup>15</sup>

The perspectives on which this report is based are not completely new, but we

seek to identify practical points of intervention that, by building upon existing patterns of change and social responses to floods and droughts, make it possible to translate these perspectives into concrete action. Our starting point in this endeavour is to outline key patterns in the wider process of socio-economic change. These patterns are the context within which detailed information from case study areas must be interpreted.

Table 1: Perspectives on Disaster Management

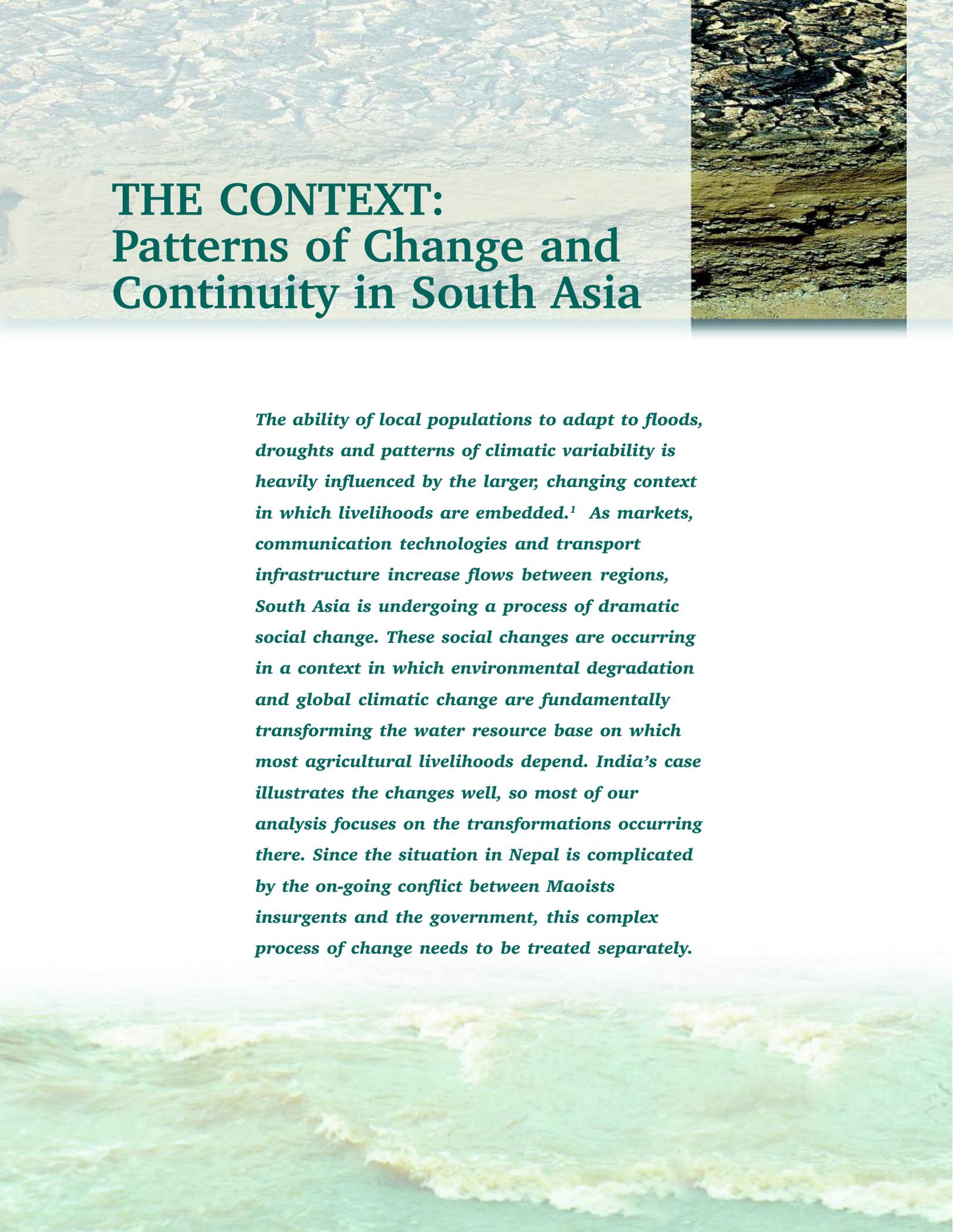
Dominant Perspective	Alternative Perspective
Disasters/conflicts viewed as isolated events.	Disasters/conflicts are part of the normal process of development.
Linkage between disaster and conditions in society during normal times is not analysed in detail.	Analysing linkages with society during normal times is fundamental for understanding disasters/conflicts.
Technical/Law and Order solutions dominate.	Emphasis on solutions that change relationships/structures in society. The objective is to reduce people's vulnerability and strengthen their capacity to respond and adapt.
Centralised institutions dominate in the intervention strategies. Participation of people, who are treated as 'victims', is relatively low.	Decentralised institutions dominate in the intervention strategies. Participation of people is paramount in intervention strategies; people treated as 'partners' in development and disaster mitigation.
Implementing agencies have little accountability and their processes tend not to be transparent to affected people.	Ensuring accountability and transparency emphasised in implementation.
Interventions are made after the event occurs.	Mitigation of disasters and conflict as an inherent part of the development process and the fundamental aim of relief.
The objective of intervention is to return to the situation before the event, i.e. to re-establish the <i>status quo ante</i> .	Disasters/conflicts viewed as opportunities for social transformation. There is recognition that neither nature nor society can, or should, return to the <i>status quo ante</i> following such a major stress. Disasters are opportunities to encourage 'good' forms of development rather than continued mal-development.

Events between two disasters also create or reduce vulnerability.

### End Notes

<sup>1</sup> Kreimer and Arnold (2000); Aalst and Burton (2002); Benson and Clay (2002); Freeman, Martin *et al.* (2002)  
<sup>2</sup> ([http://resalliance.org/ev\\_en.php?ID=1004\\_201&ID2=DO\\_TOPIC](http://resalliance.org/ev_en.php?ID=1004_201&ID2=DO_TOPIC)) Resilience Project web site accessed 1/28/04.  
<sup>3</sup> Glavovic, Scheyvens *et al.* (2002); Gunderson and Holling (2002)  
<sup>4</sup> Thompson (1994)  
<sup>5</sup> Gunderson (1999); Gunderson and Holling (2002)  
<sup>6</sup> Gunderson and Holling (2002)  
<sup>7</sup> Moench (2003)

<sup>8</sup> Dhawan (1990); Shah (1993); Meinzen-Dick (1997); Shah, Alam *et al.* (2000); Hernandez-Mora, Llamas *et al.* (2001)  
<sup>9</sup> Tsur (1990) and Tsur (1993)  
<sup>10</sup> Glavovic, Scheyvens *et al.* (2002)  
<sup>11</sup> Dreze and Sen (1989)  
<sup>12</sup> *Ibid.*  
<sup>13</sup> *Ibid.*  
<sup>14</sup> Moench, Caspari *et al.* (1999) and Moench, Dixit *et al.* (2003)  
<sup>15</sup> Disaster and Vulnerability in South Asia, Programme for *Duryog Nivaran*: A South Asian Initiative on Disaster Mitigation. ITDG, Sri Lanka, 1995



# THE CONTEXT: Patterns of Change and Continuity in South Asia

*The ability of local populations to adapt to floods, droughts and patterns of climatic variability is heavily influenced by the larger, changing context in which livelihoods are embedded.<sup>1</sup> As markets, communication technologies and transport infrastructure increase flows between regions, South Asia is undergoing a process of dramatic social change. These social changes are occurring in a context in which environmental degradation and global climatic change are fundamentally transforming the water resource base on which most agricultural livelihoods depend. India's case illustrates the changes well, so most of our analysis focuses on the transformations occurring there. Since the situation in Nepal is complicated by the on-going conflict between Maoists insurgents and the government, this complex process of change needs to be treated separately.*

## TRANSFORMATIVE CHANGE PROCESSES

The transformative nature of on-going processes of change is a central point to recognise in our analysis of the wider context. Because social and natural resource systems are evolving in ways that fundamentally reshape the context in which livelihoods exist, adaptation in livelihood systems is both an inherent, on-going process and an essential for survival.

### Peri-Urbanisation in India

India is undergoing a process of peri-urbanisation: from what was, as little as twenty years ago, a dominantly rural country, much of India has now become urban-linked. The changes are, of course, not all new. The development of railways across India in the nineteenth and twentieth centuries provided rapid connections between many rural and urban areas. Furthermore, rural and urban India has always been linked by flows of goods and people. Trade and the ever-fluid and diversified patterns of migration underlay a rural-urban dynamic of co-dependent livelihood and political systems that helped shape India's identity long before its emergence as an independent nation. At present these dynamics are changing in fundamental ways as the intensity of communication networks and the density of transport systems increase.

Where rural areas were once largely rural in character – distanced by the time required for travel and information flow – now urban areas are an hour bus ride away and

information flow is often instantaneous. Roads, television, radio, phone booths, power grids and, most recently, the ubiquitous cell phone have penetrated once isolated areas. In addition, many sleepy towns, once dominated by the slow pace of bullock carts, now rumble with trucks and the million voices of a business economy. With much of India's growth concentrated in small towns and cities, urbanisation has migrated to the countryside. Rural distances have been shortened as much by the increasing physical proximity of urban areas as they have by the speed of communication and transport. The change is fundamental. Where once access to non-farm urban jobs required migration – a fundamental change in the location of life and livelihood – now many individuals commute. Products and production are also no longer local. Milk, that most perishable of rural commodities, is processed and transported nationally. Markets that enable the bulk transport of many traditionally local resources, such as fodder and water, to be delivered economically to populations in what were once remote areas have developed. The traditional subsistence rural economy in which commodity flows were circular within a given area is now rarely found. The image of a fundamental and total dependence on local resources, never an accurate description of reality, is now more myth than ever.

**Urban characteristics are gradually spreading out and reshaping rural hinterlands.**

It is important to emphasise that the patterns described above are not new. Rural-urban inter-linkages have existed throughout history. Current patterns of change, however, while replicating existing ones, are qualitatively different. Historically, when droughts hit fodder could not be rapidly transported to distant rural areas. As a result, populations had to either migrate with their livestock or lose them. Now fodder can – and often is – transported to stricken areas. Although underlying patterns may have long historical roots, the dynamics of transport and communication have changed in fundamental ways.

Similar changes are also present throughout much of Nepal. Nepalis have always migrated outside the country for jobs. More than a million Nepalis are currently estimated to be working abroad, many just across the border in India, and remittance income is a major contributor to the economies of many rural areas. Flows are not just of labour. In the Nepal Tarai, many goods from market crops to industrial products, also come from India across the porous border. Information also flows. Small FM stations operating in local languages are increasingly common as are cell phones. Despite extreme poverty, local populations often have far more access to information and news than ever before.

All of the above changes transform the context in which floods and droughts occur and the options which local populations have for responding to the associated livelihood and other

impacts. Outlining the key elements of change in this macro context is, as a result, important.

### Demographic, Economic and Social Elements of Change

The external view of India often includes stereotypical images of a few mega-cities surrounded by a slow-moving, traditional hinterland of small villages where life proceeds at the pace of bullock carts. This image, while never truly accurate, is now a far cry from reality. Indians are not migrating in large numbers to urban areas and leaving rural areas depopulated. Data from the 2001 Census of India, for example, classify slightly over 72% of the population as rural residents and only seven per cent live in large urban cities of over one million inhabitants. The rural population declined from 77% in 1981 to 74% in 1991, but there has been no huge shift into urban areas.<sup>2</sup> Changes are more subtle: Instead of people migrating to urban areas, urban characteristics are gradually spreading out and reshaping India's once rural hinterlands.

Traditional images of a rural hinterland dotted by small villages are gradually being blurred. Villages have grown in size; many are small towns capable of supporting a diversified economic base. Statistics from the Census of India provide insights into the patterns of change.<sup>3</sup> There are approximately 981,864 habitations (villages) of various sizes in rural India. Approximately one-third of these have less than 200 inhabitants (and 15% of those have less than 100

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**The dynamics of transport and communication have changed in fundamental ways.**

inhabitants) while only 16.4% have more than 1,000 inhabitants. Villages with more than 1,000 inhabitants, however, account for nearly 55% of the total population while the one third with less than 200 inhabitants account for only 5.6% of the population. Clearly most rural inhabitants now live in relatively large villages. The change has been gradual but consistent, as the chart below indicates.

Rural distances have been shortened by the increasing physical proximity of urban areas and by the speed of communication and transport.

The chart clearly indicates an on-going decline in the percentage of the population residing in small villages

(those with less than 1,000 inhabitants) accompanied by stable or increasing populations in villages having 1,000 or more inhabitants. Even the absolute number of small villages has declined significantly in the smallest (less than 500 inhabitants) size bracket. This has important implications for the structure of rural livelihoods. Villages with large populations are much more likely than small villages to support a diversified base of services and other non-farm activities. Similar patterns are present where urban populations are concerned. As figure 4 indicates, the percentage of the population residing in small towns<sup>4</sup> has been declining, while the percentage of the population in larger towns has been increasing.

Figure 3: Population Distribution in Rural Villages of India

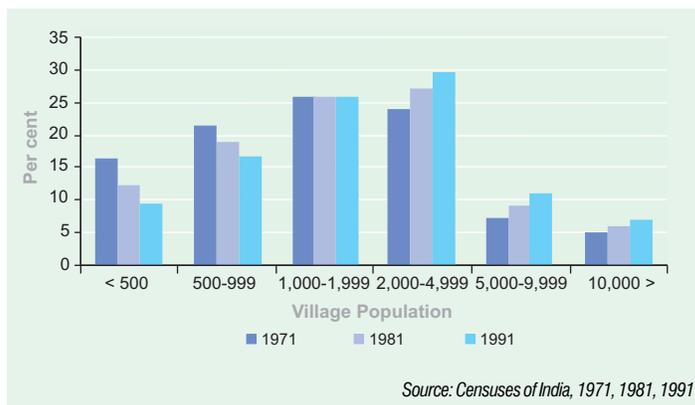
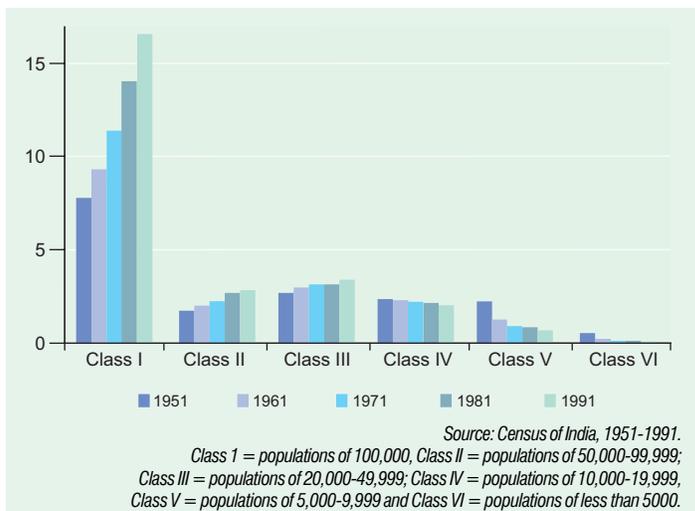


Figure 4: Change in Town Sizes in India



The increasing concentration of the population in large villages has been accompanied by other changes in basic infrastructure such as electricity, telecommunications and roads. As figures 5 through 7 clearly document, access to infrastructure has increased dramatically. The number of public call offices (a critical indicator of telephone access in rural areas, where most people cannot afford private phones), has increased from near zero to almost 350,000, and most of these are linked to the national network. Similarly, electrification has increased dramatically and is now levelling off as most villages are, at least nominally, connected to the national grid. Most are also linked to paved roads.

While the data underlying the above charts need to be interpreted with care (electrification, for example, indicates

connection to the grid, not the availability of power when users may need it), they do indicate a basic change in rural infrastructure.

Another feature is the reduction in times taken for commuting. Twenty years ago, the pace of a bullock cart travelling on unpaved roads often determined the travel times between villages and towns or urban areas. Under the best of conditions, such travel took substantial time and during the monsoon season many villages were effectively cut off. Now, the presence of all-weather roads has facilitated the extension of public and private buses and local taxi services far into once isolated areas.

Communication and transport systems are only cut during extreme flooding events. In many regions, the distance an individual farmer or worker can travel within a day to sell produce or search for a job has expanded from a few to many tens (or hundreds) of kilometres. Complementing the ability to travel, telephones and cell phones allow individuals to communicate with others in distant locations and to find out about a wide variety of factors (from jobs to market conditions) that influence their livelihood options and choices. Finally, with a power supply from the national grid and with access to transport, many non-farm activities that could not have been undertaken earlier are now possible in these areas. These changes are illustrated well by the situation in the Annur and Palladam blocks of Coimbatore District in Tamil Nadu (Box 1).

Figure 5: Growth in the Number of Public Call Offices

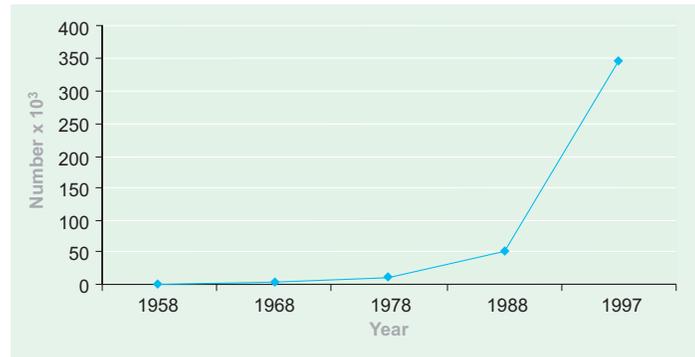


Figure 6: Expansion of the Road Network

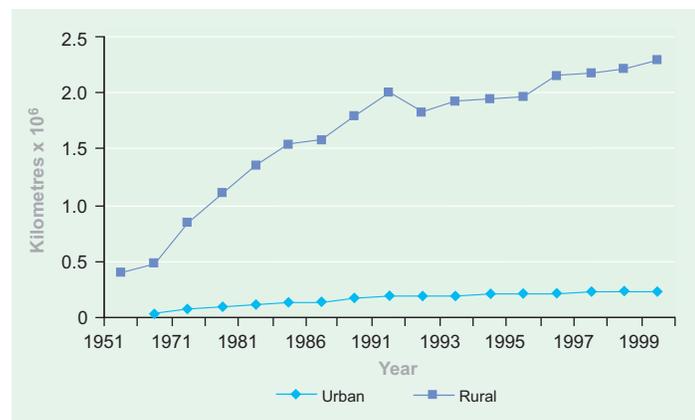
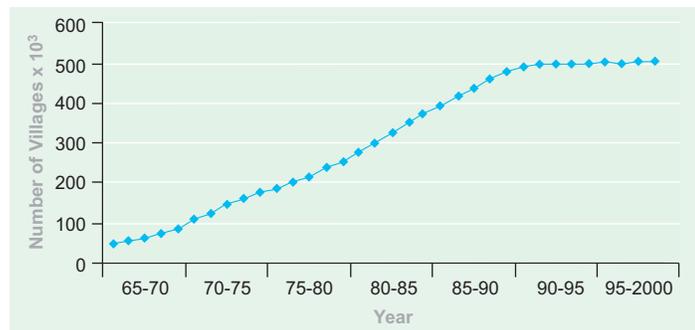


Figure 7: Village Electrification



The situation described in the box 1, while extreme in the extent of the economic shift out of agriculture, is typical of most of our case study areas. Overall, rural areas are much more closely connected to urbanised towns and livelihood options than ever before. Large towns and small cities are more numerous and, as a result, much less

## BOX 1 Livelihood Change: Annur and Palladam Blocks, Coimbatore, Tamil Nadu

Annur and Palladam blocks of Tamil Nadu have undergone a rapid process of economic change in livelihoods in recent decades. Both areas were dominantly agricultural as recently as the early 1990s. Now, although many families may still be classified as agricultural, income from non-farm related activities dominates heavily. This is made clear by data collected by Tamil Nadu Agriculture University on the income sources of two villages, Kodangipalayam and Kattampatti.

### Income Sources of the Household, Kodangipalayam (%)

Land ownership size group	1990-91				2000-01			
	Own farm	Off farm	Non-farm	Total	Own farm	Off farm	Non-farm	Total
Marginal	47	28	25	100	18	10	72	100
Small	70	10	20	100	28	4	68	100
Medium and Large	88	0	12	100	45	0	55	100
Landless	0	81	19	100	0	22	78	100

### Income Sources of the Household, Kattampatti (%)

Size group	1990-91				2000-01			
	Own farm	Off farm	Non-farm	Total	Own farm	Off farm	Non-farm	Total
Marginal	55	29	16	100	36	19	45	100
Small	83	10	7	100	67	7	26	100
Medium and Large	88	0	12	100	65	0	35	100
Landless	0	77	23	100	0	47	53	100

The above tables clearly document dramatic increases in the reliance on non-farm activities as a source of income and the parallel declines in incomes from both farmers' own land and from agricultural labour working on land owned by others. In both villages, substantial declines in groundwater levels have caused farmers to reduce the intensity of cultivation and to increase the areas devoted to crops such as millets that, while they require less water, also generate far less income. At the same time, roads, power and communication systems have entered the villages, thereby enabling large and medium scale farmers to diversify into non-farm activities. The number of power looms has increased greatly and farmers have also switched into quarrying and other small businesses. With increases in these activities, marginal farmers and the landless, who once derived most of their income from off-farm agricultural activities, now derive by far the largest share of income from non-farm labour sources. Now, as the tables below document, the area devoted to irrigated crops has declined substantially and the area planted with sorghum or left fallow has increased.

### Changes in Cropping Pattern, Kodangipalayam

Year	Area (%)				Total area (ac)
	Cotton	Banana	Sorghum	Fallow	
1990-91	7	18.00	19	2	20.24
2000-01	0	0.04	40	22	20.19

### Changes in Cropping Pattern, Kattampatti

Year	Sugarcane	Vegetables	Sorghum	Fallow	Total area (ac)
1990-91	59.6	17.4	5.7	1.4	17.40
2000-01	25.4	9.8	20.9	20.9	18.11

The above shifts rest on a further change: most of the wells of smaller farmers no longer function, so almost all intensive cultivation is done by a few, relatively large, farmers. Landless, marginal and small farmers have little direct dependence on agriculture as a major source of income and their livelihoods are, in consequence, relatively insulated from the direct impact of drought. Instead of relying on agriculture they either work locally or even commute as much as 60 km per day to their primary work in factories or quarries. As long as drinking water supplies are available and the economy in general remains robust, their livelihoods will remain secure even in times of drought.

Source: Personal communication with K.Palanasami, Director, Water Technology Centre, Tamil Nadu Agricultural University, Coimbatore, field work conducted for the British Geological Survey COMMAN Project.

physically distant from rural areas. At the same time, the radius of contact for individuals living in rural areas has expanded. Many rural areas are, from this perspective, peri-urban.

### Changing Livelihood Systems

Changes in rural infrastructure and demographics have fundamental implications for livelihoods. Data from the Census of India and National Sample Survey indicate that permanent migration has declined. As Mahindra Dev points out, however, ‘both Census and NSS ignore or severely underestimate short duration (circular) migrants and commuting labour. The National Commission on Rural Labour (NCRL) estimates more than 10 million circular migrants in the rural areas alone’.<sup>5</sup> Commuting is part of a number of livelihood options in many sites studied by the partners in this project. Furthermore, micro-studies in other areas indicate that commuting is common; in fact, it is a major factor contributing to labour mobility.<sup>6</sup> Citing a study by Srivastava (1998), Dev points out that: ‘increased labour mobility has contributed to breaking down the isolated nature of rural labour markets and greater integration between rural and urban labour markets. The overall impact of labour out-migration in the recent period has been to put an upward pressure on wages and accelerate changes in production relations’.<sup>7</sup> The depth and extent of changes in production relations may be limited by the low educational levels of much of the rural workforce,<sup>8</sup> but structural changes are clearly occurring.

Increases in commuting and short-term migration coupled with existing long-term migration have probably increased remittance income flows to rural areas. These remittance flows may, as in some other parts of the world, such as Vietnam,<sup>9</sup> represent a major source of capital for many of investments in education, non-farm businesses, housing infrastructure and agricultural intensification. In Nepal, remittance income flows were, according to official data, equivalent to NRs 22 billion in 2000; an amount nearly equal to that earned through exports.<sup>10</sup> This suggests that structural changes in rural areas may be heavily influenced by changes in the wider economy and by the remittance income flows that enable local investment. This said, in some cases the structural changes are driven as much by declines in water availability or other shortages as they are by wider socio-economic opportunities. Nepalis have migrated to India and other areas to work for centuries. The outflow of people has accelerated since 1997, when passports were made available in district headquarters and societal stresses increased as a result of the Maoist insurgency. In some case study villages in Gujarat, the stresses forcing diversification have included declining water levels. The situation in Bhanavas village described in the box 2 is illustrative.

Economic data for rural India show substantial diversification from solely agriculture to a variety of non-agricultural activities (Figure 8). As can be seen, the number of ‘other

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**Changes in rural infrastructure and demographics have fundamental implications for livelihoods.**

## Groundwater Depletion, Drought and Economic Change, Bhanavas

In the village of Bhanavas of Gujarat, depletion of groundwater has led to drastic declines in the area under irrigation and in agricultural production. As with other villages in the study area, agriculture has nearly collapsed as a source of income. According to villagers, the drought situation was manageable until 1998 although groundwater levels were declining. The situation changed dramatically in 1999, when well depths reached hard bedrock and drought conditions intensified. The impact this had on the irrigated area cultivated with different crops is clear in the table below:

### Decline in Production of Selected Crops, Bhanavas

Crops	1998 (%)	1999 (%)	2000 (%)	2001 (%)	2002 (%)
Groundnut	100	50	No cultivation	No cultivation	Crop failed
Cluster beans	100	30	No cultivation	No cultivation	Crop failed
Maize	100	50	No cultivation	No cultivation	Crop failed
Bajra	100	70	50	25	Crop failed
Wheat	100	50	25	10	5
Mustard	100	50	No cultivation	No cultivation	No cultivation
Tobacco	100	10	No cultivation	No cultivation	No cultivation

Source: Primary survey, focus groups discussions, 2003

The total cultivated area in the village is approximately 200 acres. The above table presents the area under various crops as a percentage of the 1998 cropping pattern. Focus group discussions conducted by VIKSAT indicate that irrigated production had dropped to approximately just 10 acres in 2002.

Declines in agricultural production have had major impacts on other activities. Animal husbandry, while still a major economic activity in the area, has declined due to lack of fodder. As local agricultural activities have declined, migration out of the village for work has increased. Data collected by VIKSAT indicate that migration has taken a variety of forms including:

- Long-distance seasonal movement to places such as Banaskantha for sharecropping. Banaskantha is an adjacent district and still has some sources of irrigation water. In some cases, entire families migrate for part of the year and in other cases only adult male members sharecrops.
- Migration or commuting to nearby towns in search of employment in the urban informal sector and in diamond cutting and polishing industry in Satlasana, Surat and Ahmedabad. In some cases entire families have migrated on a relatively long-term basis.

Migration and, to a lesser extent, commuting for wage labour have served as backup income sources for villagers in locations such as Bhanavas throughout history. Now, however, climatic and infrastructural changes processes and economic diversification have enabled the entry of activities such as diamond polishing to rural areas. Combined with the push effect of groundwater depletion and drought, the presence of new economic opportunities has catalysed major livelihood shifts at the local level.

Source: VIKSAT field survey

workers' has increased substantially and now exceeds both cultivators and agricultural labourers.

The above patterns conform to trends in India and many other parts of the world as well. As Daniel Start

indicates; 'recent surveys suggest that non-farm sources account for 40-45% of average rural household income in sub-Saharan Africa and Latin America and 30-40% in South Asia with the majority of this coming from local rural sources rather than urban migration'.<sup>11</sup>

The causes of this shift are subject to substantial debate, but a variety of push and pull factors are probably important. The size of operational landholdings in agriculture has, for example, been declining steadily. The number of marginal (less than one ha) holdings has increased dramatically over recent decades and the total area under large (>10 ha) and medium (4-10 ha) landholdings has declined, as has the total agricultural area within large holding size classes (Figures 9 and 10). As a result, many farmers probably find themselves with insufficient land for cultivation. In addition, factors such as declining access to groundwater and declining groundwater quality in areas affected by over-extraction, drought and general degradation of the natural resource base represent substantial push factors.

Push factors are not, however, the only considerations at play. In most rural areas, non-agricultural wages are higher than agricultural wages.<sup>12</sup> Among other things, key results from Sundaram’s analysis indicated ‘widespread gains in labour productivity getting translated into equally widespread and significant growth in average wage earnings per worker and per capita’ along with ‘a reduction in the share and size of the workforce in agriculture’.<sup>13</sup> Casual wage labourers in agriculture received, on average, 25.48 IRs/day while casual workers in rural areas received 30.89 IRs/day on public works projects and 37.49 IRs/day in non agricultural activities. Urban casual workers receive slightly more – on average 39.75 IRs/

Figure 8: Rural Livelihood Change in India

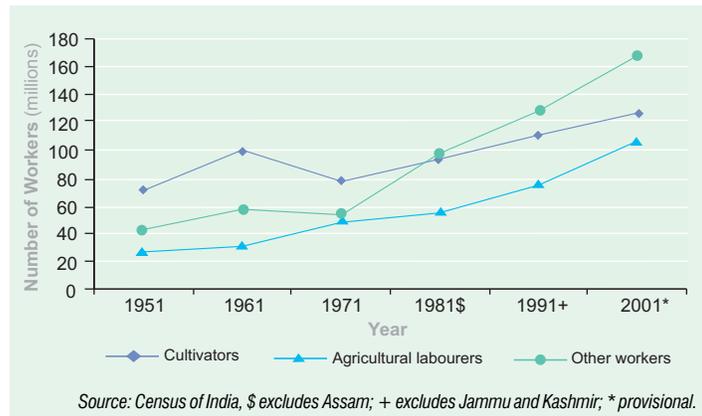


Figure 9: Landholdings by Size Class in India

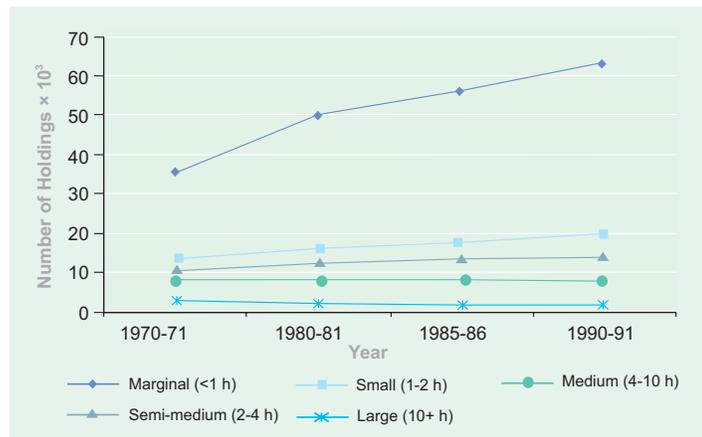
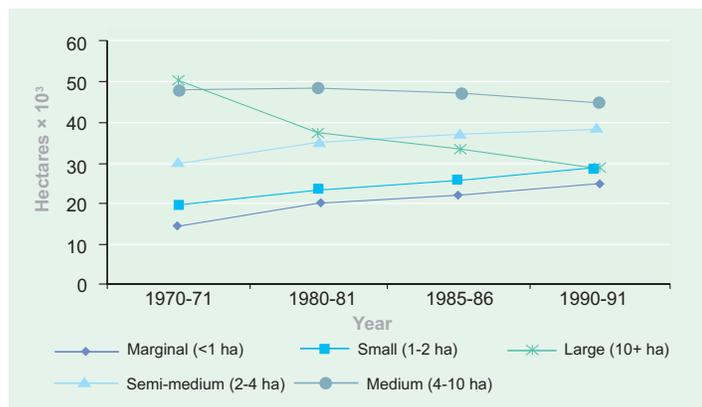


Figure 10: Total Area Under Different Landholding Size Classes



day.<sup>14</sup> Of all occupations, casual labour in the agricultural sector is the worst paid. While some individuals may chose to remain as agricultural labourers for a variety of cultural or

other reasons, it often represents the parking place for the poor. It is the primary source of work for those who have been unable to find jobs in other sectors. When other opportunities are available, the wage differentials represent a substantial factor pulling labour out of agriculture. Other pull factors are probably also important. These range from income diversification and reduction of exposure to the risks associated with agriculture to increased status and access to services, such as schools for educating children, that are often associated with employment in the non-farm economy.

Many of the advantages of engagement in the non-farm economy are now accessible to individuals living in some formerly rural areas, particularly larger villages and towns and small cities.

Many of the advantages of engagement in the non-farm economy are now accessible to individuals living in some formerly rural areas, particularly larger villages and towns and small cities. As already discussed, rural India is becoming peri-urban and is being penetrated by urban forms of communication, transport and power systems. As Start citing Bryceson (2000) comments: 'Straddling both rural and urban economic domains, rural people increasingly depend on urban labour markets, urban remittances, urban trade and urban social networks'.<sup>15</sup> Rural household economies are also increasingly diversified as Deb *et al.* found in a survey of Aurepalle village in Andhra Pradesh: 'in 1975, households were recorded in the survey as drawing on at most three sources of income. The majority of the farmers had one (37%) or two (55%) sources. By 2001, the number of income sources increased to five and no households except those in the non-farm category had only one

source of income. The majority of the farmers (59%) had between two and four sources of income. Sixteen per cent of the households had five sources'.<sup>16</sup> Similar patterns were found in another village surveyed by Deb and friends.

It is important to recognise that diversification, the growth of the rural non-farm economy and the higher wage rates found outside of agriculture do not, as previously emphasised, imply a one-directional process involving economic shifts away from agriculture. Where agricultural opportunities exist or can be enhanced, rural, and even urban, inhabitants often shift toward it as a primary source of livelihood. This is clearly evident in the case of work undertaken by Samaj Pragati Sahayog at Neemkheda and other villages in the Narmada Valley. There, investments in watershed treatment and drought proofing have catalysed substantial reductions in labour migration and increases in the intensity of agricultural activities and associated livelihood changes.<sup>17</sup>

Overall, the process of peri-urbanisation appears to combine increased interaction between rural and urban areas, growth in rural towns and villages, the growth of the rural non-farm economy and, even within the farm economy, diversification of livelihood systems both within and beyond agriculture.

### The Changing Nature of Community

As India becomes increasingly peri-urban and livelihood systems change, the nature of communities is changing as well.

Historically the diverse groups living within rural villages often depended on the same single agricultural system for livelihoods and survival. Their livelihoods were interdependent. In addition, most people had strong place-based identities. Society was neither totally mobile nor fluid and migration, while always technically possible, often was a limited option families could chose in response to livelihood or community constraints. As a result, villages were, in the most generalised sense true communities. Shared interests and needs cut across the boundaries of family, caste and religion. People, whatever their divisions, needed to interact and to maintain institutions, such as the traditional *panchayat*, to moderate their interactions within the geographic boundaries of villages and local areas. Village communities often really were communities representing groupings bound together by more than chance location.

In today's world, it is unclear how often villages remain as true, place-based communities. Many of the ties binding diverse groups within villages are now much weaker. Non-agricultural livelihood systems, for example, often depend on networks of contacts and relationships that extend far beyond (and may not include) others within a given village location. Furthermore, as the national economy diversifies and rural areas become increasingly peri-urban, it is far more possible for individuals or groups to opt out of communities by migration or, less drastically, by ceasing to maintain or observe the traditional institutions of

community. Shared rituals and the religious calendar are breaking down in urban and peri-urban areas. The *panchayat's* writ has been eroded and village elders can often do little if individuals within a village ignore their dictates or if, more subtly, the village as a whole gradually ceases to care. While rallying points often catalyse communities to organise around issues including water, such organisations often are terrains of actions.

A similar process is also occurring at the caste and family level. Almost two decades ago, roads, and the increased access to markets they enabled, were identified as a primary factor underlying the break-up of joint families in the Garhwal Himalaya.<sup>18</sup> As market access increased, nuclear family units became less and less dependent on larger joint family groupings for economic survival. Historically, key livelihood activities (in this case, the sale of milk and access to grasslands) required long-distance seasonal migration while others (maintaining subsistence crops) were village based. Both activities were essential for survival but individual nuclear family units lacked sufficient labour to maintain both livestock and agriculture. Access to roads changed this by enabling families to sell milk and new market crops as well as to remain limited within the village. As the requirement for seasonal migration decreased, so did the economic interdependence within joint family groups and, over a period of less than two decades, most joint families within the village ceased to function as single

**Reduction of exposure to the risks associated with agriculture is often associated with employment in the non-farm economy.**

economic units. This process is common. As roads, markets and communications increasingly penetrate through rural areas, dependency relationships within families and caste groupings change. In some cases, interdependence may increase (commercial agriculture for example, often requires capital injections obtained through urban jobs), while in other cases it decreases. In a general sense, however, the web of interdependent relationships is likely to be less and less bounded by location. Instead, people depend on networks of relationships within occupations or other groups that may or may not be influenced by physical location.

One way to think about changes in a community is through the density of interactions. In a traditional village, individuals interact with others in the village frequently to meet multiple needs. Ties often include kinship, the daily activities of farm operation, numerous shared household tasks, the maintenance of joint (village) infrastructure, and larger economic integration. Development often nibbles away at the density of interactions within a village grouping. A water tap in the house, for example, while minimising drudgery also reduces a woman's need to communicate and get along with the other women in her neighbourhood. The presence of a local bus service reduces an individual's dependency on others in his village for agricultural labour. Access to large markets reduces the mutual dependency between individual producers and individual traders. The presence of a

rice mill reduces the hours women traditionally had to share pounding and husking grain. A sense of community is often created through numerous shared tasks and regular interaction among a small, defined group. Development processes reduce the number of tasks and the frequency of interaction required within narrowly defined village groups. In a peri-urban village, while individuals may still know their neighbours, most do not need to interact with them on a daily basis to meet multiple basic needs. Thus, density of interactive ties declines.

Community continues to exist but it is more individualised and less defined than it was traditionally. Office, trade groups, markets, schools, temples and water taps become the paramount spaces of interaction for people rather than the village or housing cluster. As a result, as peri-urbanisation proceeds, villages may increasingly become place-based agglomerations of people that lack the density of cross-cutting relationships and sets of identities required to create a sense of community. The degree to which this is true, of course, varies greatly between locations but it is a central issue influencing the way in which all communities respond to droughts, floods and long-term resource management needs. Acting individually, people are capable of greater mobility and can see or take advantage of opportunities much faster. This said, they may become more vulnerable as the nature of social capital changes and the presence of some forms of local voluntary support networks, declines.

**Community continues to exist but it is more individualised and less defined than it was traditionally.**

## Rural-Urban Interlinkages in Nepal

In Nepal, recognition of urban-rural inter-linkages, the parallel to peri-urbanisation processes in India, is nothing new. Results from research conducted in Nepal over a decade ago on this are central and relevant to our project. This research, which was funded by the Swiss National Research Foundation, involved a four-year study between 1989 and 1992 and focused on rural-urban inter-linkages.<sup>19</sup> Its background was the debate within Switzerland in the late 1980s about overseas development policies, specifically with reference to Nepal. Switzerland had been providing rural development aid to Nepal in money, men and material for three decades. Concentrated exclusively on rural areas, the guiding objectives of the Swiss supports were to see that rural impoverishment was minimised and rural to urban migration was halted. Neither objective was satisfactory despite years of interventions. The above study was guided by the need to look at rural development anew and to answer whether swinging the pendulum to the other end of urban development was the answer.

The study concluded that rural and urban were the ends of a continuum and, that it was becoming more and more difficult to categorise an area or a family as purely rural or urban. The report drew heavily on a concept developed by researchers at the East-West Centre, Hawaii,<sup>20</sup> *desakota* (village-town in Indonesia) to understand this continuum in which

families spread their income baskets from farming in Bajhang in Nepal to urban jobs in Bangalore.

From this particular case of migration from the roadless Nepali hinterland to the (later) silicon valley of India, the study concluded that it was necessary to reconceptualise rural development by recognising the inevitability of migration, which subsistence farmers use as a survival strategy. Development strategies would not succeed if they attacked the idea of mobility as such; instead they had to consider options such as the following:<sup>21</sup>

- eliminating the physical and social stress of migration;
- shaping migration patterns by improving opportunities in nearby towns to reduce migration distances; and
- providing migrants opportunities to re-invest their skills and capital back home.

Looking at six socio-economic sub-systems of rural-urban inter-linkage (the exchange of goods and role of markets; technology diffusion; resource mobilisation and exploitation; migration and employment; information and value exchange; and external effects), the study generated the following conclusion:

- There are no clear-cut boundaries for rural and urban goods.
- Markets and the system of information flow are the interface between rural and urban areas.
- Imports to rural areas from urban or combined rural-urban areas always exceed rural exports,

**As market access has increased, nuclear family units have become less and less dependent on larger joint family groupings for economic survival.**

the balance being maintained by remittances.

- The balance of trade between rural and urban areas can be reversed if the terms of trade change or if rural inhabitants are able to figure out creative ways to add value to good.
- Urban centres are the basic source of technology and innovations.
- Transport technology is a critical element in enhancing market linkages and urban-rural interactions.
- Time and roads (as transport development is currently defined) are required for technology diffusion, a necessary precondition for technological modernisation.
- Resource exploitation of rural areas occurs primarily because of the under pricing of rural goods and the overpricing of urban ones, which in turn occurs because national policies favour urban consumers
- Access to water and forest products is a crucial element for both rural and urban households in determining their capacity to innovate.
- Commercialisation of agriculture has led to new forms of travel and resource flow that often favour men rather than women and thus lead to gender exploitation.
- Where migration is a survival strategy, success from an equity perspective depends upon whether or not the migration is individual with a breakdown of the social

order or if it is internalised by the social system and hence able to provide its votaries social support.

- Information exchange, especially commercial, happens through intermediary institutions, such as middlemen (which, incidentally, farmers love and development experts decry). The state as a supra-institution has attempted to fill this role but, in most cases has failed. Success in development is highly dependent on this relationship and whether farmers are able to take advantage of it or it takes advantage of them.
- Education plays a crucial role in deciding who are the winners and who are the losers. This factor is also important in nurturing entrepreneurs.
- Development has been broadly defined as ‘the increase in available options and decision-making capacity of persons and collectives in respect of their own lives’. Increasing this degree of freedom commensurately implies reducing potential risks, which villagers shrewdly calculate.
- Traditional state sponsored banking has failed villagers in many areas, they then fall back on informal arrangements.
- Land tenure issues are important since absentee landlordism stymies a villager’s proclivity towards creativity.

Overall, the study emphasised the ongoing nature of exchange between rural and urban areas and the fact that such linkages introduced continuous

**Overall, study results emphasised the ongoing nature of exchange between rural and urban areas and the fact that such linkages introduced continuous processes of change into livelihood systems.**

processes of change into livelihood systems. If anything, such change processes have accelerated in Nepal as roads and communications have improved and out-migration, always present, has increased. Some have been pushed out of traditional livelihoods by resource limitations or by the continuing impact of the Maoist insurgency. Others are pulled by access to better resources and opportunities abroad. Whatever the cause, migration and the increased flow of people and goods between rural and urban areas are transforming the nature of life throughout Nepal much as they are in India and other parts of the world. The possibility of being able to return to pre-existing economic and social structures is slight. Similar processes of transformation are also present in natural resource systems.

### Transformative Change in Water Resources and Climate

Degradation of the environmental resource base on which much of the population in South Asia depends has been the subject of extensive analysis for more than three decades.<sup>22</sup> These changes are, in many cases, well known and it is beyond the scope of this paper to review them here. What is important to recognise, however, is the transformative nature of such changes, particularly in relation to our primary focus on water resources and climatic dynamics.

What do we mean by transformational change? The concept of irreversibility has been central to debates over environmental management and the

transformative impact of humans on environmental systems has been recognised for decades.<sup>23</sup>

Transformational changes take the concept of irreversibility one step further; they involve fundamental shifts in system function or dynamics that occur as a consequence of changes in individual parameters or aggregate changes in multiple parameters.

### Water Resources

Where water resources are concerned, human use and management practices alter hydrologic systems in ways that fundamentally transform their dynamics and consequently the roles such systems play in floods and droughts. Both groundwater and surface water systems illustrate the transformative nature of such processes well. In India, the number of energised wells has increased from a few thousand in the 1950s to over twenty million.<sup>24</sup> This has irreversibly changed the nature of agricultural systems and is having equally major impacts on the groundwater resource base. In some regions, water resources accumulated over thousands of years are used up in periods as short as a few decades. These changes are transformational; they do not just affect the volume of water stored in aquifers. Aquifer compaction or subsidence has long been known as a fundamental and often irreversible impact of extraction that changes the hydraulic properties of an aquifer. Beyond this, however, the impact of changing water levels has resulted in decreased base flows in surface streams, changes in patterns of recharge and discharge across broad

Many of the changes now taking place in water resource and climatic systems are transformational.

areas and, in some cases, changes in regional vegetative cover and the distribution of wetlands.<sup>25</sup>

In some cases, the impact of groundwater changes on surface systems has been evident for decades.<sup>26</sup> Such changes may affect surface flows even in situations, such as in the Ganga basin, where storage in aquifers remains huge.<sup>27</sup> Groundwater extraction often transforms the hydrologic system even where there is no threat of aquifer depletion in any quantitative sense. Last year in Rajasthan, despite the best monsoon in a decade, almost no flow has reached the renowned, but now dry lakes in Udaipur.<sup>28</sup> Similarly, many wells in rural Gujarat, including our field sites in Satlasana, remain dry despite highest levels of rainfall in years. This is, in all probability, the result of transformational changes in recharge patterns and flow systems within aquifers that reflect both the massive increase in pumping that has occurred over recent decades as well as more subtle effects from changes in vegetative cover, landuse and direct water management interventions such as the construction of water harvesting structures.

The situation is similar where surface water resources are concerned. Decades of efforts to control flooding in the Ganga plain have resulted in the construction of an extensive, though partial, network of embankments. These structures serve as much to block drainage as they do to retain flood waters within river

channels.<sup>29</sup> They are paralleled by an equally massive system of diversion structures, irrigation canal networks and municipal water supply systems that move water away from river systems to points of use. In addition to large water control structures, raised networks of roads, train tracks, field bunds, field level canals, local water harvesting ponds and other structures have reshaped drainage patterns in rural areas. In urban areas, reshaping of the natural drainage system is even more dramatic. Impermeable paved areas, urban drainage channels, buildings and the increasing presence of walls around everything from housing to industrial complexes have often changed the natural drainage system beyond recognition.

Recognition of the way embankments and other human interventions reshape surface hydrologic systems is nothing new, as the policy review section later in this report documents in detail. Overall, changes in regional landuse and drainage structure transform hydrologic systems in complex ways. The rate at which runoff occurs, the shape and timing of stream hydrographs in response to precipitation and the duration of flooding in specific areas, all change in ways either subtle or dramatic. In sections of the Ganga basin within both India and Nepal, our own field work indicates that areas once subject to brief intermittent flooding now remain underwater for many months at a time. As with the impact of embankments on flood drainage and on the increase in

**Recognition of the way embankments and other human interventions reshape surface hydrologic systems is nothing new.**

the height of stream bed levels, many impacts are likely to become evident only in hindsight. Furthermore, transformative changes in water systems accompany equally fundamental changes in human settlement, livelihood and other systems. These changes are, in most cases, just as irreversible or transformative as the changes in the physical system.

### Climate

In addition to major changes in social and hydrological systems, South Asia is also likely to be affected by global climatic changes. Although the impacts of global climatic change on conditions within regions are difficult to predict, current research suggests that climatic changes in India and Nepal are likely to exacerbate both droughts and floods. Details related to climate change are discussed in Annex I and are briefly summarised below.

At a regional level, the rise in temperature associated with climatic change is believed to have already resulted in decreased evaporation and precipitation in semi-arid and arid regions as well as in retreats in Himalayan glaciers. Such changes may increase the frequency of droughts and reduce base flows during the dry season. At the same time, changes in stream flows introduced by the increase in temperature, changes in precipitation and changes in the form of precipitation in mountainous regions from snow to rain appear likely to increase both flooding and hot season

water deficits. Increasing rates of melting and shifts in the snowline to higher elevations are likely to change the hydrological balance. Precipitation which occurs as rain rather than as snow, which gradually during the dry season, will now immediately run off into streams. At the same time, declines in snow storage will affect the availability of water during the dry season. Mirza *et al.* (1998) investigated the effects of changes in precipitation resulting from global warming on future flooding in Bangladesh. Standardised precipitation change scenarios from four GCMs were used for the analysis. The most extreme scenario showed that for a two degree celcius rise in global mean temperature, the average flood discharge for the Ganga, the Brahmaputra, and the Meghna could be as much as 15%, 6%, and 19% higher, respectively.

Overall, the results of recent research on global climatic change, although far from conclusive, strongly suggest that climatic variability and climatic extremes in the form of floods and droughts are likely to increase. These changes are also transformative and are likely to reshape the basic weather patterns within which current agricultural livelihood systems have evolved.

### The Implications of Transformative Change in Water and Climate

The transformative nature of change processes affecting water and climate in South Asia has fundamental

Although the impacts of global climatic change on conditions within regions are difficult to predict, current research suggests that climatic changes in India and Nepal are likely to exacerbate both droughts and floods.

implications for both long-term water management and disaster mitigation and relief. Four points are of particular importance to note:

**Surprise is likely to increase:** Because water and climate systems are changing as a result of many interacting factors, predicting the duration, intensity and location of floods and droughts may become increasingly difficult despite scientific advances.

**Parameters needed for prediction must evolve:** Although predicting change will be difficult, parameters for doing so must be developed. In the case of groundwater, for example, access to the resource has been a major factor stabilising agricultural production and enabling regional development for much of the last five decades in India.<sup>30</sup> Where changes in groundwater availability associated with overdraft and quality declines affect the ability of groundwater to play this role, droughts will have a much more impact than where resource availability remains high. Because groundwater conditions are highly variable and often depend on very localised factors, however, the precise location and timing of such impacts can only be determined if groundwater monitoring is reoriented in a way that allows for the incorporation of local information into drought warning systems.

**The ability to re-establish systems following disruption is likely to change:** The case of groundwater is again illustrative in showing that being able

to returning to the *status quo ante* is unlikely. In areas where drought and groundwater overdraft have forced reductions in irrigated agriculture, the re-establishment of intensive agricultural livelihoods faces major challenges. In many, if not most, situations, recovering of groundwater levels may require both reductions in pumping and a sustained period of precipitation above historically average levels. The re-establishment of agricultural livelihoods in the immediate post-drought period may not, as a result, often be possible.

**The design of effective water management systems will face increasing challenges:** As our ability to predict flows, extreme events, sediment loads and other basic hydrological parameters (never particularly robust to begin with) declines with climatic change, the ability of societies to implement water management approaches requiring precise data in order to operate will also decline. Embankments, canals and many social infrastructure systems for water management (such as volumetrically based water rights) require relatively precise information on the volumes of water available and the probability of specific flows or sediment loads. As climatic change and other transformations in water resource systems proceed, the ability of hydrological science to produce information with the degree of precision required is likely to decline.

The impact of transformational changes in water resource and climatic systems threatens the core worldview

As our ability to predict flows, extreme events, sediment loads and other basic hydrological parameters declines with climatic change, the ability of society to implement water management approaches that require precise information on such parameters in order to operate will also decline.

on which most hydrological science has been founded – the assumption of stationarity. With climate change, the stationary hydrological cycle becomes dynamic. This introduces fundamentally a new dimension. Most hydrological analyses are based on statistics. Historical data on stream flows, the duration and intensity of precipitation, the hours of sunlight, humidity, evaporation rates and so on serve as baseline measures for predicting the statistical frequency of likely events in the future and for developing the design characteristics of water supply, irrigation and flood control infrastructure. A dynamic hydrological system implies changes in the characteristics of the above mentioned components. As a result, historical data are of little utility as a decision support tool. Transformational changes in the characteristics of climate system thus raise basic questions regarding the utility of historical data for projecting future conditions. Everyone from municipal water utility districts seeking secure water supplies for burgeoning urban populations to insurance companies trying to calculate risks have suddenly become far less sure of the foundations on which their activities are based. Kaczmarek *et al.* (1996) summarise the hydrological situation for large projects in the context of global climate change well:

“For hundreds of years, people have adapted their habits and economic activities to what they assumed were the natural climatic and hydrological

conditions. Implicit in this assumption was that these conditions were stable. Despite the knowledge that, through dams, diversions, and water intakes, man has altered natural hydrological regimes, the fundamental assumption of stationarity of key hydrological processes still dominates the planning and designing of water resources development projects. This assumption may no longer be valid, because projected global environmental disturbances can cause serious alterations in the stochastic properties of hydrological time series. Moreover, the long time scales usually associated with large-scale water projects make them particularly sensitive to anthropogenic climate change.<sup>31</sup>”

Whether or not the initial assumption of stationarity was justified, those involved in water management must shift from approaches based on bounded variability to approaches capable of responding to a much larger reality involving inherent uncertainty and the limitations of current knowledge systems. This shift has major political as well as scientific implications. Water resource development possibilities are directly linked to the politics of global finances. Greater variability implies that larger projects must be designed to accommodate a wider range of conditions. This, in turn, is likely to entail higher economic and social costs.<sup>32</sup>

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## THE INSTITUTIONAL LANDSCAPE: THE HISTORY OF GOVERNMENT AND NGO ACTION

The institutional landscape in which floods and droughts occur is a critical factor in determining how disasters are perceived and what responses to them are adopted. While a full review is beyond the scope of this report, targeted analysis of the evolution of flood and drought policies in Nepal and India along with insights on selected NGO activities serves as a foundation for discussion. In particular, this review emphasises how a long history of focus on water control has led to development of relatively rigid governmental approaches despite their acknowledged limitations. It also highlights the emergence of new approaches, particularly in response to drought that interlink the activities of governments, NGOs and local communities through watershed programmes.

### Nepal's Flood and Drought Policy

Over the last fifty years, Nepal has considered herself so rich in water resources that the subject of drought has been almost totally ignored even though much of the country falls in what can be called the 'semi-arid tropics'. While floods have spawned state intervention, much of the hope for flood control has been placed on the construction of high dams. While only the Kulekhani I has been constructed so far, twenty-nine dams have been proposed in the Nepal Himalaya by the Nepali government. Kulehni-I was designed with a life span of 100 years, but lost its dead storage in just 13 years of operation. One major cloudburst in July 1993 alone accounted for half the sedimentation of the reservoir. Instead of high dams for flood control, Nepal has constructed weirs and barrages for irrigation that divert dry season flow.

The institutional landscape in which floods and droughts occur is a critical factor in determining how disasters are perceived and what responses to them are adopted.



The irrigation inspection bunglow did not fulfill its intended function because the irrigation barrage (shown in facing page) became defunct one year after its completion as the Tinau River changed its course.

The history of the intervention of the modern Nepali state in water resources in a meaningful way began fifty years ago, when the Department of Irrigation was established. In medieval Nepal the small *Baise* and *Chaubise* principalities provided state support for the construction of *raaj kulos*, but in the modern period, the state's role has been limited to classifying land into four categories – *abbal*, *sim*, *doyem*, *chahar* – and levying taxes accordingly. This categorisation was based primarily on the availability of water

for multiple crops as well as on land and soil type. Farmer groups construct and themselves manage irrigation systems called Farmers Managed Irrigation Systems (FMISs). It is estimated that there are about 16,500 FMISs through out the country.<sup>33</sup>

Most FMIS, are built, not on the major rivers but on their tributaries and small streams fed by base flow. These systems mobilise voluntary labour from their village support base in order to repair and maintain canals and intake structures on a regular basis. The same co-operative practices are used in response to floods. Villagers volunteer and contribute materials to re-build or rehabilitate damaged diversions, intakes and canals. Only since the entry of foreign aid in the 1960s, and more intensively in the 1970s, has the state started encroaching on community's based responses to flood-damage.<sup>34</sup>

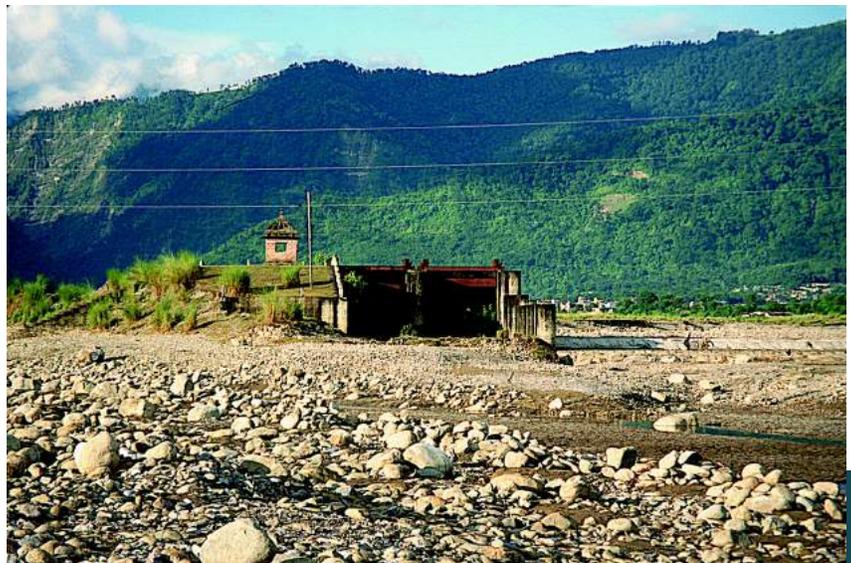
The involvement of the Nepali state in irrigation schemes was a response to the interventions of British India in the United Provinces. The first example of such intervention was the Sarada Barrage, the agreement for which was concluded in 1920. The barrage itself became operational in 1928, but Nepal was able to use its share of the waters of the Mahakali River only in the 1970s after getting a loan from the World Bank. What was noteworthy about the agreement on Sarada was that irrigation water seemed to have no value for the Nepali state: Compensation from the British to Nepal was in the form of cash and land.<sup>35</sup> The events in India prompted nimesis in

Nepal as Rana rulers initiated the first state-supported irrigation schemes in Trijuga and Manushmara to grow commercial crops. This paradigm of state support for and intervention into irrigation systems grew in leaps and bounds after the overthrow of the Rana regime in Nepal in 1951.

The main instrument of state intervention in river regimes is the Department of Irrigation (DoI) under the Ministry of Water Resources. It's activities are guided by the Water Resources Act of 1992 and the Irrigation Policies of 1992 and 2003.

Handling drought is also implicitly part of the DoI's activities because the conventional definition of drought is simply the failure of rains to occur in an expected manner. The understanding is that drought is taken care of when irrigation waters are provided to areas that do not have them. Agricultural areas of Nepal that are physically not irrigable due to their

**Over the last fifty years, Nepal has considered herself so rich in water resources that the subject of drought has been almost totally ignored even though much of the country falls in what can be called the 'semi-arid tropics'.**



*The defunct Tinau Barrage in Butwal. Shortly after construction the main channel on the Tinau River shifted, bypassing the barrage. As a result, the new irrigation system never functioned.*

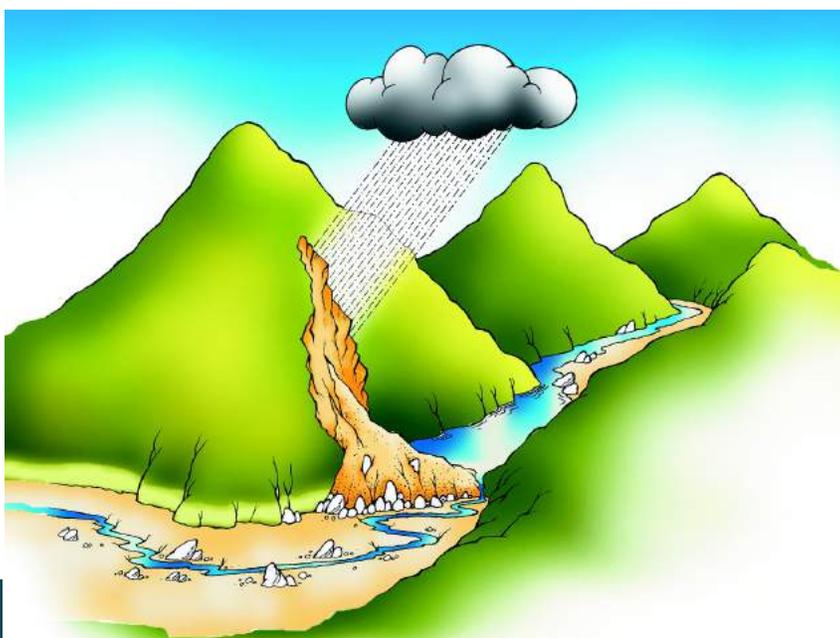
topography and physical limitations do not fall under DoI's mandate. If the rains fail, then areas that are rain-fed suffer, but this matter lies beyond the purview of the DoI. The DoI claims that the Department of Agriculture (DoA) should look into drought, but the DoA also claims not to be responsible and identifies the Prime Minister's Relief Fund as the proper source for assistance. In essence, in areas of rain-fed agriculture, it is farmers and their families that cope with drought in whatever manner they can. Often this entails extending seasonal migration for work (called *nimek garne*) by leaving earlier and staying out for a longer period.

Floods in the High Himalaya are different from those in the Middle Hills and the Tarai. In the mountains, a glacial lake can engender devastating floods when the moraine dam that holds the melt water of the lake bursts.

The rapid melting of glaciers in recent years has expanded many moraine-dammed lakes. When temperature increases in the summer, pressure from melt-water or piping also increases, and these dams give way with devastating consequences for settlements and infrastructure downstream. In the Middle Hills, the most devastating floods are caused by *bishyaris* (landslide-dammed lakes). The fact that Nepali language has a word to describe this phenomenon indicates that it has a long and natural history, and that landslide did not start with so-called deforestation.<sup>36</sup> It is the geological instability of Himalayan mountain slopes coupled with intense cloudbursts that cause these devastating floods. Floods in the Tarai are different from in the hills but similar to those in Bihar and Uttar Pradesh plains.

Nepal's Natural Calamity (Relief) Act was first formulated in 1982. The Act gave importance to relief and preparedness. It also made provisions for establishing the Central Disaster Relief Committee, under the Ministry of Home. The Act was amended last time in 1992, which broadens the scope of the previous instrument to include all disasters. The Act has been extended beyond natural disasters to include man-made calamities such as industrial accidents. The amended Act also encompassed the preparedness and rehabilitation aspects of disaster management. The Act can be operationalised before and during a calamity to prevent or mitigate its effect, and after a disaster to provide relief and rehabilitation. The Act envisages the formation of a hierarchy of committees

**The involvement of the Nepali state in irrigation schemes was a response to the interventions of British India's United Provinces.**



*Bishyari is a common but stochastic event in the Middle Hills of Nepal.*

Source: Dixit (2002)

for dealing with natural disasters. The topmost committee is the *Kendriya Daibi Prakop Uddhar Samiti* (Natural Calamities Central Relief Committee) which consists of the home, physical planning and health ministers as well as the secretaries of the finance, defence, home, foreign affairs, construction and transport, water resources, communication, forest, environment, labour and social welfare and supply ministries. The committee also consists of the secretary of the National Planning Commission and representatives from the army, police, Nepal Red Cross Society, Nepal Scout, Department of Mines and Geology, Department of Hydrology and Meteorology, Social Welfare National Co-ordination Council and representatives from affected districts. Other committees are Relief and Remedy Sub-committee; and Supply, Resettlement and Rehabilitation Sub-committee; regional committees, district committees; and local committees.

In addition to the above committees, a special disaster unit was created to function as the committee's secretariat. Along with the Natural Calamity (Relief) Act, long-term plans for disaster mitigation were enunciated in the Soil and Watershed Conservation Act of 1982. The provisions in this Act were never used. At the same time a Natural Calamities Assistance Fund was established under the chairmanship of the Home Minister.

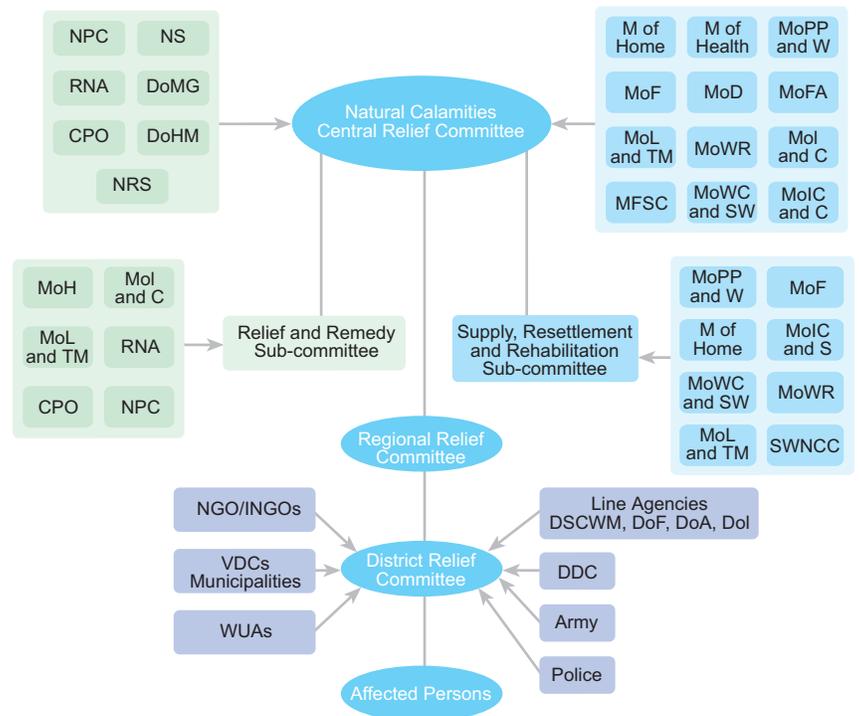
At present, depending upon the administrative unit area where disaster occurs, committees at various levels are

supposed to be activated. Overall, the Act does not seem very effective. It is outdated because the structure of the ministries included in the formation of the committees has changed and some ministries have been removed since the last amendment. In addition, the Act does not specify the functions, duties and operation procedures of the sub-committees or their linkages with other committees.

In addition to the above acts, following the declaration of International Decade

In the Mid-Hills, the most devastating floods are caused by *bishyaris* (landslide-dammed lakes).

Organisations Related to Disaster Mitigation in Nepal



- NPC: National Planning Commission
- NS: Nepal Scout
- RNA: Royal Nepal Army
- CPO: Central Police Office
- NRS: Nepal Redcross Society
- DoMG: Department of Mines and Geology
- DoH: Department of Hydrology
- MoF: Ministry of Finance
- MoL and TM: Ministry of Labour and Transport Management
- MoF and SC: Ministry of Forest and soil Conservation
- MoD: Ministry of Defence
- SWNCC: Social Welfare National Coordination Council
- DSCWM: Department of Soil Conservation and Watershed Management

- MoPP and W: Ministry of Physical Planning and Works
- MoFA: Ministry of Foreign Affairs
- MoWR: Ministry of Water Resources
- MoL and C: Ministry of Information and Communication
- MoIC and S: Ministry of Industry, Commerce and Supply
- MoWC and SW: Ministry of Women, Children and Social Welfare
- VDC: Village Development Committee
- WUA: Water User's Association
- DDC: District Development Committee
- DoF: Department of Forest
- DoA: Department of Agriculture
- Dol: Department of Irrigation
- INGOs: International/Non-government Organisations

for National Disaster Reduction (IDNDR) by the United Nations, a National Action Plan for Disaster Mitigation was also prepared. In 1994, Nepal established the National Committee for the IDNDR under the chair-personship of the Home Minister. However the committee faced teething troubles particularly due to lack of co-ordination in implementation. Subsequently, in 1995 the plan was modified. The following year, the government approved it, by renaming it the National Action Plan for Disaster Management in Nepal, which also included a disaster preparedness action plan, a disaster response plan, a disaster reconstruction and rehabilitation plan, and a disaster mitigation plan.<sup>37</sup> The plan prioritised activities, delineated responsibilities, and stipulated time frames for monitoring and evaluation. It specified (a) priority activities to be undertaken in the fields of disaster management (including flood mitigation), (b) responsible agencies, and (c) time periods for completion of mitigation activities. The absence of an institutional basis, however, has resulted in lax monitoring and meagre application of knowledge.

### Organisations

Beyond planning and legal structures, organisations provide support at both local and national levels. The formal agencies are of two types – support and implementation. The first type provides financial, material and technical support, which is *post facto*. Agencies of the second type are responsible for implementing field-based programmes.

The central-level organisations are responsible for policy formulation, planning and development of water resources. The National Development Council (NDC) is the highest body that reviews plan and programmes (including the water resources development plan) prepared and submitted by the National Planning Commission (NPC). Headed by the Prime Minister the council has representation from all sectors. Created to discuss national development issues and secure consensus on national development, the council has political orientation. The NPC allocates resources, reviews progress of plans, monitors and evaluates departmental performances. Though the concept of central planning is being questioned, this hierarchic mode persists.

**Ministry of Home Affairs:** Ministry of Home Affairs is the central agency in relation to disaster management. The Ministry mainly formulates the national policies on disaster management and implements them. It also carries out immediate rescue and relief works in the event of natural disasters through the Department of Narcotics Control and Natural Disaster Management. The main function of the department is to carry out disaster management activities with the concerned agencies and it co-ordinates in the matter of disaster-related programmes with related organisations.

**Ministry of Water Resources:** At a more operational level, the Ministry of Water Resources (MoWR) is mandated as the agency responsible for overall

**With the insurgency, the central authorities face far more difficulty in taking effective action to mitigate disasters.**

planning, policy-making and implementation of the country's water resources. It receives support and advice from Water and Energy Commission (WEC) and its Secretariat (WECS). The WEC/WECS was recognised on January 4, 1999 to provide better services to the government by entrusting the agency with wide range of tasks.

*Water and Energy Commission Secretariat (WECS):* WECS is a multidisciplinary institution engaged in the development of water and energy in a co-ordinated way. It also supports the government in formulating water-related policy and strategy. The functional approach of this Secretariat is to accomplish studies, surveys and investigations and to render opinion on issues relating to the development of the nation's water and energy resources.

*Department of Water Induced Disaster Prevention (DWIDP):* The Government of Nepal established the Department of Water Induced Disaster Prevention on 7<sup>th</sup> February 2000. Now, this department is implementing the disaster rehabilitation and management activities in the country. The main strategies and policies of the department are as follows:

- Prepare and implement a water induced disaster management policy and plan;
- Carry out hazard mapping and zoning;
- Strengthen the disaster networking and information system;
- Establish disaster rehabilitation system;

- Carry out disaster related public awareness programme at community level;
- Prepare and implement a flood plain action plan;
- Strengthen institutional set-up and capacity;
- Implement disaster reduction measures; and
- Develop disaster database, GIS and DIS systems.

In organisational terms, flood control was the responsibility of a section under the DoI which was primarily concerned with gabion building and embankment protection along streams that threatened villages or urban settlements. In the 1990s, the Japanese Aid Agency, JICA provided support to this unit. In 2000, the unit was separated from DoI and became the full-fledged Department of Water Induced Disaster Prevention (DWIDP). In pursuit of country-wide mandate, DWIDP has set the following targets:

- To identify potential disaster zones and to stock emergency relief material in all five regions of the country by 2007;
- To establish warning systems all over the country and to put in place infrastructure for mitigating predictable disasters by 2017; and
- To make sure that social and economic losses are reduced to the levels experienced in developed countries.<sup>38</sup>

The department's current portfolio of projects includes the following:

- A river management policy and a disaster mitigation policy are under preparation

**Over recent decades the Government of Nepal has essentially used a hierarchic approach to respond to floods.**

**Systematic efforts by the government to ameliorate the impacts of flood in Nepal started only after 1980.**

- A risk vulnerability mapping and zoning programme is underway
- In most high risk areas, a disaster networking and information system programme will be developed
- On the non-structural side of disaster awareness, a community level disaster preparedness programme, which will also include relief and rehabilitation measures, is being developed
- An important feature of the DWIDP is the international inundation committee that, through dialogue, aims to mitigate the effects of inundation of Nepali villages and agricultural land by interventions such as embankment building across the border in India.
- A GLOF and landslide debris flow management programme aims to identify high-risk areas and examine to determine any economically viable actions that can be used as mitigating measures.

*Department of Irrigation (DoI):* The Department of Irrigation under the Ministry of Water Resources was previously responsible for flood mitigation and river control works in Nepal. Now, it deals with disasters likely to affect government-built irrigation systems. It carries out flood control works by constructing small dykes on riverbanks to save irrigation systems.

*Department of Hydrology and Meteorology (DHM):* Another organisation with important role in flood mitigation is the DHM. It also

has critical role from the perspective of water resources planning and development. The department maintains a network of climatic and rivers flow gauging stations. Lack of sophisticated instruments for hydro-climatic data collection and insufficient budget are its main problems. The department was shifted to the Ministry of Science and Technology from Ministry of Water Resources in 1997. The DHM played a co-ordinating role in the project that lowered the water level of the Tsho Rolpa Glacier Lake to minimise the hazard of its breach. The DHM is currently working on flood forecasting based on a real time data collection and transmission system by satellite and GIS tools.

**Department of Soil Conservation and Watershed Management (DSCWM):** This department is one of the main divisions of the Ministry of Forest and Soil Conservation (MFSC), which has relevance to floods. By improving land management and increasing agricultural productivity through conservation and utilisation of watershed resources the department focuses on conservation to help community meet their basic needs. The aim is to link forestry, agriculture, livestock, water, and landuse with the objective of helping the community conserve and manage land and water. The department gives importance to mobilising local community and raise their awareness to implement conservation measures by forming user groups.

Many agencies work independently. They collect materials, funds, and distribute them directly to the communities affected by floods. Efforts to create a panel of institutions have been *ad-hoc* and show lack of commitment for change. The current approach has been dominated by the centralised state and its agencies while local governments and community-based institutions receive less focus.

### Policies of the Indian government regarding drought mitigation<sup>39</sup>

The 20<sup>th</sup> century has been marked by frequent droughts in India. Eighteen large-scale droughts occurred, (1903-05, 1957-60, 1966-71, 1984-87, and 1997-99) with some extending over periods of three to six years.<sup>40</sup>

According to Government of India estimates, there are one or two years of drought every five years in the semi-arid and arid regions of India.

Over recent decades the Government of India has essentially used a two pronged strategy to respond to droughts. The first element of this strategy emphasises relief to reduce the impact of drought on affected human and livestock population. Development of grain reserves, the public food distribution system, massive food and cash for work programmes, the Calamity Relief Fund, programmes for fodder distribution and well drilling etc... are all State relief measures designed to ensure income streams and the ability to purchase food when regions are affected by drought. Longer-term programmes focus on

mitigation primarily through structural activities intended to 'drought proof' regions. These programmes, because they reflect long-term initiatives intended to help people adapt to drought-prone regions (or, in contrast, adapt the regions to the people) are the primary focus of our analysis below.

### History

Systematic efforts by the government to ameliorate the impacts of drought in India only started after national planning for economic development was initiated. In Rajasthan, the establishment of a research centre at Jodhpur in 1952 was the first step toward developing of systematic responses to drought. This centre was intended to focus on key issues in desert areas such as sand-dune stabilisation, shelterbelt plantation and afforestation. In 1959, this centre was named the Central Arid Zone Research Institute (CAZRI) and given full responsibility for developing drought mitigation strategies. In the Second and Third Five-Year Plans, the government sought to address problems in drought-affected areas through dry farming techniques like moisture and water conservation measures developed by CAZRI research.

In 1970-71 the government launched the Rural Works Programme with the objective of creating jobs and assets in areas with low and uncertain rainfall. Its intention was to establish infrastructure such as irrigation systems, rural roads, soil

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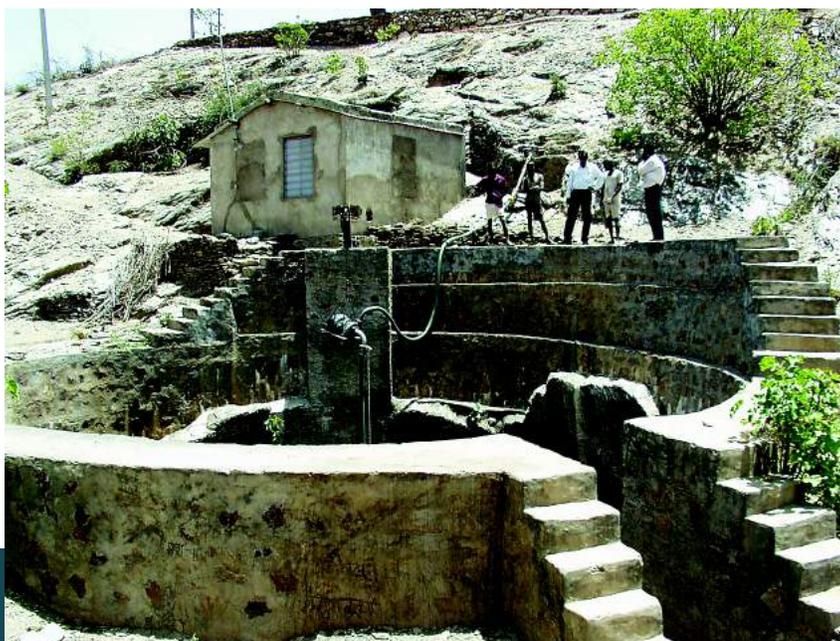
**Systematic efforts by the government to ameliorate the impacts of drought in India only started after national planning for economic development was initiated.**

conservation, projects, afforestation, and pasture development and to simultaneously generate employment for the rural population. This programme evolved into the Drought Prone Area Programme (DPAP), which emphasised an expanded set of development strategies based on labour intensive schemes such as medium and minor irrigation, road construction, soil conservation and afforestation.<sup>41</sup> The Fourth Five-Year Plan continued to put emphasis on dry land farming technology and the 'All India Coordinated Research Project for Dry land Agriculture,' later renamed the Central Research Institute for Dry land Agriculture (CRIDA) was set up. Initially, 24 pilot projects were started to serve as training and demonstration centres for technologies relating to soil management, water harvesting, improved agronomic practices and drought-resistant crops.

The programme in the Fifth Five-Year Plan followed the strategy of integrated area development laid down by the Planning Commission Task Force under the chairmanship of B. S. Minhas, then member Planning Commission in 1971.<sup>42</sup> The Task Force recommended that the programme be based on an analysis of the resource endowment of and the potential for the development of the project areas. It recommended that the programme focus on the integrated development of agriculture through conservation, development and optimal utilisation of land, water, livestock and human resources. The need to provide stable income and employment to the weaker sections of the rural society was also emphasised. In 1977-78, a new programme the Desert Development Programme (DDP) was started on the recommendation of the National Commission on Agriculture to look into the problem of desert areas including the cold desert areas of Jammu and Kashmir and Himachal Pradesh. Overall, the DPAP and the DDP were aimed at drought proofing through the adoption of an integrated area development approach that would stabilise both production and employment.

A task force was set up by the Ministry of Rural Development under the Chairmanship of M. S. Swaminathan in 1982 to review the DPAP and the DDP and suggest modifications in the approach followed. As a result of its recommendations, the emphasis on agricultural productivity in dry as well as irrigated areas and on vegetative cover was increased. The Task Force emphasised the need for planning the

**The need for new approaches with conceptually clear goals, capable planning, strong methodologies of implementation and the involvement of people's institutions became clear in the 1980s.**



*In dry land regions groundwater is the main source of water.*

programmes on a watershed basis in an integrated manner. The objective was ecological restoration through proper land and water management. The task force recommended providing subsidies for land improvement irrespective of the size of holding and implementing schemes such as farm forestry and water harvesting, which involve community participation. The main thrust of the DPAP and the DDP in successive plans continued to be on income generation and infrastructure schemes but with an ever-widening focus. In the process the programmes deviated considerably from the objective of ecologically integrated development through drought proofing and control of desertification and were widely perceived as having an inadequate impact.

Because of their inadequate impact, the Central Sanctioning Committee (CSC) reviewed the programmes closely in 1987. This review found that continued expansion, which brought in activities that were poorly integrated and focused, was responsible for the poor results. Initially, programme activities had been confined to employment generation; later, scarcity mitigation in drought prone areas was added as an objective. In the Fourth Five-Year Plan emphasis shifted from employment generation to durable asset creation and in 1971 the Fifth Five-Year Plan the Task Force had recommended addition of integrated development in drought affected areas as a goal. The latter was a complex addition, under which the programmes could implement a very wide range of activities to restore the ecological

balance of areas through integrated watershed development in the hope that it would insulate them from the effects of recurring drought.

The CSC also observed that low levels of investment in widely dispersed areas, implementation of schemes without proper feasibility studies, diversion of funds to unapproved schemes and high administrative expenditure had diluted the focus of the programmes. In May 1988, another National Committee under the Chairmanship of Y. K. Alagh emphasised the need for new approaches with conceptually clear goals, capable planning, strong methodologies of implementation and the involvement of people's representatives. As a result of the reviews there was greater conceptual clarity in the Seventh Five-Year Plan since it clearly spelled out drought proofing and control of desertification as the main objectives of the DPAP

**Although a financial breakdown of the actual investments in different types of treatment under the watershed programme is unavailable, experience suggests that most of the expenditure has been on structural activities.**



Rainwater harvesting anicut in Alwar, Rajasthan.

and the DDP. The government also decided to reduce the range of activities undertaken through the DPAP and DDP and to focus on soil conservation, land shaping/development, water resource conservation/development, afforestation and pasture development. In addition, micro-watersheds were identified as the primary unit for planning and development. Annual plans for the DPAP and the DDP were prepared for each district and after approval from state and central governments, implementation is initiated. The role of voluntary organisations in identifying and articulating peoples' needs was also identified.

Although the restoration of the ecological balance continued to be the main objective of these programmes, especially during later years, evaluations found that the sharp focus on drought-proofing and desertification control had not been effectively articulated leaving ample scope for activities that did not directly contribute to drought mitigation. As a result the direction of the programmes was diluted. Factors such as the perceptions of state governments, spending capabilities of government departments and the pressure of interest groups also played a major role in determining actual implementation. Activities were often isolated and the concept of the watershed as a development unit was never realised. Furthermore, despite programme guidelines stipulating that DPAP and DDP activities be integrated with other

development programmes most were implemented independently resulting in duplication and waste. In some cases, state governments reduced normal allocations for DDP areas and used the programme to fund regular development activities. Reviews also indicated that the bureaucracy generally gave low priority to these programmes.

The above factors meant that asset creation was poor and that the maintenance of the water harvesting and other structures suffered. Beneficiaries were not motivated to assume responsibility for maintenance even when the benefits were substantial and government departments did not have sufficient funds for maintenance in their budgets. As a result, most water harvesting structures were filled with silt or damaged within three years after completion. Furthermore, in some cases despite the official emphasis on participation, beneficiaries are sceptical or even hostile to project activities. Farmers, for example, demolished structures such as bunds on private fields. Where people had been motivated to participate from the planning stage, however, their enthusiasm appeared visible and they protected the structures. The problems related to water harvesting structures were mirrored with respect to the larger goals of the programmes. As the CSC review stated:

“ The review committee finds that despite these programmes, ecological degradation is continuing especially in drought-prone and desert areas. Water table has gone down. Drinking water problem has not been solved. Forest

**By 1987 the DDP and the DPAP were seen as having failed to neutralise the adverse impact of environmental degradation underway in drought-prone areas.**

cover has been depleted. Severity of drought has increased. Thus ecological degradation in the dry land areas in the country today appears greater than a few decades ago.”<sup>43</sup>

In sum, by 1987 the DDP and the DPAP were seen as having failed to neutralise the adverse impact of environmental degradation underway in drought-prone areas. Despite attempts to improve performance, this did not change in subsequent years. The programmes failed not so much because of the wrong identification of the problem or inadequate allocation of funds, but mainly because of (a) poor and *ad-hoc* planning without any serious respect for the watershed approach; (b) the almost complete lack of people’s participation and (c) weak coordination and lack of integration among activities undertaken by the different agencies involved in the projects’ operation. As a result of these programme failures and the occurrence of widespread drought in 1997 (which affected 93 million people) the government decided to initiate a new programme of Integrated Watershed Management (IWM).

### The Current Approach: Integrated Watershed Management

The IWM programme was launched throughout India with substantial financial and technical support. Its objective was to manage and rejuvenate depleted natural resources on a watershed basis. Under the National Watershed Programme for Rainfed Areas, implementation has taken place in a large number of

watersheds across the country. In Rajasthan, watershed development is the state’s primary area of activity for natural resource regeneration and groundwater recharge. The budgetary allocation for IWM, which is the largest for any department, is shown in table 2. Since the programme has yet to be seriously reviewed its outcomes are unknown.

Although a financial breakdown of the actual investments in different types of watershed treatment under the watershed programme is unavailable, our own review and direct experience suggests that most of the expenditure was on structural activities. The main costs of the IWM programme comprise the construction of check-dams and other water harvesting structures of various sizes. The physical treatment of watershed areas through, for example, the digging of contour bunds is another major expenditure. Direct investments in changing vegetative cover (planting trees or sowing different grass varieties) are low, as are investments in improving the efficiency of water use in agriculture. Although the participation of local populations in watershed programmes is heavily emphasised, social investments in organisation, for example the creation of watershed management groups and the building of their capacity, represent an extremely small fraction of the total amount expended.

In sum, the long-term response to drought by the Government of India has focused on programmes for drought-

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**The perceptions of governments, the spending capabilities of government departments and the pressure of interest groups play a major role in determining quality of implementation in watershed schemes.**

Table 2: Watershed Development in Rajasthan: Physical and Financial Achievements from 1974 to 2002

Year	NWDP*		Special Plans		Outsider Helping Plans		Total	
	Area (ha)	Rs (10 <sup>6</sup> )	Area (ha)	Rs (10 <sup>6</sup> )	Area (ha)	Rs (10 <sup>6</sup> )	Area (ha)	Rs (10 <sup>6</sup> )
1974-75	-	-	59,681	0.627	-	-	59,681	0.627
1975-76	-	-	54,582	4.858	-	-	54,582	4.858
1976-77	-	-	18,248	0.07	-	-	18,248	0.07
1977-78	-	-	8,299	0.672	-	-	8,299	0.672
1978-79	-	-	16,303	6.73	-	-	16,303	6.73
1979-80	-	-	35,649	9.276	-	-	35,649	9.276
1980-81	-	-	32,356	23.631	-	-	32,356	23.631
1981-82	-	-	46,530	21.945	-	-	46,530	21.945
1982-83	-	-	41,840	31.566	-	-	41,840	31.566
1983-84	-	-	36,086	37.508	-	-	36,086	37.508
1984-85	-	-	17,368	12.428	-	-	17,368	12.428
1985-86	-	-	29,677	58.108	-	-	29,677	58.108
1986-87	1,329	0.843	66,249	166.907	-	-	67,578	167.750
1987-88	11,597	9.077	30,870	87.78	-	-	42,467	96.857
1988-89	9,645	9.020	26,638	102.356	-	-	36,183	111.376
1989-90	11,763	12.098	31,460	109.135	-	-	43,223	121.234
1990-91	9,000	83.364	24,057	142.074	-	7.1	33,057	232.538
1991-92	24,633	75.082	22,485	111.016	1,407	36.512	48,525	222.610
1992-93	95,555	146.401	28,281	137.883	5,431	87.207	1,29,267	371.491
1993-94	1,04,882	208.687	46,942	128.498	14,146	127.189	1,65,970	464.374
1994-95	77,879	245.200	38,581	243.069	25,568	139.799	1,42,028	628.068
1995-96	96,087	350.050	97,468	236.052	25,614	251.568	2,19,169	837.670
1996-97	1,16,015	354.827	36,355	118.366	29,700	290.641	1,82,070	763.834
1997-98	75,950	257.87	26,459	266.715	36,105	240.015	1,38,514	764.600
1998-99	89,459	381.449	79,872	408.024	13,500	147.379	1,82,831	936.852
1999-00	85,792	393.271	69,910	426.227	1,102	18.234	1,56,804	837.732
00-2001	1,19,518	389.582	51,463	574.889	247	8.209	1,71,228	972.680
01-2002	60,783	365.488	25,576	432.366	-	-	86,359	797.854
<b>Total</b>	<b>9,89,887</b>	<b>3,282.310</b>	<b>10,99,285</b>	<b>3,898.776</b>	<b>1,52,820</b>	<b>1,353.853</b>	<b>22,41,992</b>	<b>8,534.939</b>

Source: Watershed Rajasthan Annual Report 2001-2002, pp.16-17.  
 \*National Watershed Development Programme

proofing and economic development in drought-prone areas. Most of the activities under these programmes have focused on physical interventions, such as the building of water harvesting structures. This focus on structures is duplicated in the governmental responses to flood.

**Public distribution system:** The public distribution system (PDS) in India, which started as an *ad-hoc* war time measure to mobilise food supplies to prevent undue rise in price with a network of 0.474 million Fair Price Shops (FPS), is now one of the largest systems in the world. The

concept of PDS has evolved in the wake of critical national level food shortages of the 1960's, as a major policy instrument to distribute essential commodities to the people, particularly the weaker section of the society, on an assured and regular basis at reasonable prices. It also works as an effective anti-inflationary measure and makes significant contribution in raising the nutritional standard of the poor. In the earlier period following its inception the PDS had an urban bias. Gradually, however, coverage in the rural areas increased. Radhakrishnan and Subbarao (1997) argue that the PDS has played a limited role in providing food grain access for the poor despite operation for four decades. The Impact of PDS on poverty and nutritional status was seen by them to be minimal and at an exorbitant cost.<sup>44</sup> In contrast, Sagar (2003) argues that PDS has proved to be the cornerstone of the food security in Rajasthan.

From a drought mitigation and management point of view the PDS networks have been playing a significant role through the distribution of 17,451 thousand tonnes of foodgrain annually through fair price shops all over India.<sup>45</sup> The strength of the system can be judged by total grain flowing through the fair price shops. Today the agricultural situation in the country is completely different from what it was when the PDS was established. Large stocks of foodgrain, much in excess of that required for strategic purposes have been accumulated. PDS

allotments have not been utilised in the states with the highest concentration of poverty because the issue price is close to the market price. But the network is available for relief work, at the time of natural calamities in any part of the country. As drought is recurrent phenomenon the system turns out to be effective in distribution of essential commodities to affected populations during times of crisis.

**Rural development programme:** In addition to the PDS programme there are many target oriented rural development programmes intended to improve the economic condition of rural households and their ability to cope with natural calamities. These programmes can be broadly categorised into three categories, namely: (i) Area development programmes, (ii) Employment generation programmes, and (iii) Poverty alleviation programmes. The current list of programs under these broad headings is as follows:

**The PDS was designed to address local level food shortages by distributing essential commodities to the people.**



Use of mechanised pump in a dugwell in semi-arid region.

(i) *Area development programmes:*

1. National Watershed Development Programme for Rainfed Areas (NWDPRA) and Integrated Watershed Development Programme (IWDP)
2. Drought Prone Area Development Programme (DPAP)
3. Desert Development Programme (DDP)
4. Tribal Area Development Programme (TADP)
5. Special Area Development Programme such as Mewat area, Dang area and Border area in Rajasthan

in the country. Although these schemes were initially intended to provide a minimum off-season employment guarantee of one hundred days to landless agriculture labourers, at present the schemes could only provide 10-15 days employment to each household in target groups annually. Therefore, these schemes have in fact failed to make any tangible impact on the livelihood of targeted groups

(iii) *Rural poverty alleviation programme and individual beneficiary programmes:* It started with SFDA and IRDP and now;

- i) Swaran Jayanti Gram Swarozgar Yagna (SGSY)
- ii) Indira Awas Yojna (IAY)

(ii) *Employment generation programme (EGP):* There are four rural employment generation schemes

**PDS networks have been playing a significant role in the distribution of food.**



Rajasthani women in food for work programme.

- iii) Pradhan Mantri Gramodaya Yojna - Rural Housing (PMGY)

(iv) Rural infrastructure development:

- i) Rural electrification
- ii) Rural roads
- iii) MP Local Fund Development Programme
- iv) MLA Local Fund Development Programme
- v) Accelerated rural Water Supply Programme (ARWSP)

Rajasthan has made steady progress in poverty reduction. The major impact of these efforts has been that during periods of serious droughts, large-scale migration of human and cattle population does not take place to the same extent, the capacity of the system to respond to the needs of the population has increased, and a certain amount of resilience has been developed. Nevertheless, during periods of severe drought vulnerable populations including, landless agricultural labourers and marginal farmers still require government support for provision of employment, fodder, drinking water etc. This is because agriculture still remains a gamble in the monsoon and the sustainability of agriculture-based livelihoods remains an issue. Recurring droughts have a major impact on development. Burgeoning human and cattle populations are putting increased pressure on natural resources and negating developmental efforts. As a result, rural development strategies need to be reevaluated.

## Government Responses to Floods in India

“Floods being natural phenomena, total elimination or control of floods is neither practically possible nor economically viable. Hence, flood management aims at providing a reasonable degree of protection against flood damage at economic costs.”<sup>46</sup>

The above quote captures government perceptions regarding the nature of drought in India. Conspicuous for its absence is an acknowledgement that the vulnerability of livelihoods and ecosystems to floods can be reduced by engaging with variability and change rather than attempting to control and regulate these systemic processes. Rather than using socio-economic transformations in both urban and rural landscapes, natural resource variability and human mobility and adaptability as starting points, conventional wisdom treats both the environment and the populations it is home to as fixed in time and space, thus limiting the scope for innovation and adaptation. The extent to which the official perceptions and policies of government agencies in India are both *willing* and *able* to go beyond the structural approach and respond to the dynamic and changing nature of both society and water resource conditions deserve scrutiny.

## Colonial Perceptions and Policies

Towards the latter half of the 18<sup>th</sup> century, the East-India Company made its maiden large-scale attempt to insulate the rivers of the Bengal Delta,

**Agriculture still remains a gamble in the monsoon and the sustainability of livelihoods for people dependent on agriculture remains threatened.**

in the process drastically reordering existing modes of revenue and property collection and the codes of social administration. In consequence, the traditional and flexible responses to natural patterns of inundation practised by the inhabitants of the delta were systemically undermined by the colonial perceptions of natural phenomena as ‘calamities’. Moreover, once floods were seen as adversely affecting the fields that were the main source of its revenue, the government changed its official perception about floods. Floodwaters were now to be controlled, regulated and subsequently brought under absolute subjugation. In other words, the imperatives of rule and administration were decisive in determining and organising an agenda for flood control. Embankments were the first structural measures adopted as flood control measures to prevent flood waters from submerging revenue-generating land.

The policy of embanking rivers proved counter-productive. As experience was gained, it rapidly became apparent that embankments not only clogged drainage systems and magnified flood heights, but also were a substantial drain on the resources of the colonial government to construct and maintain. As a result, in the early decades of the 20<sup>th</sup> century, the colonial government began abandoning its approach to flood insulation. Such a shift not only marked a significant departure from the initial colonial flood control strategies, it also highlighted the geomorphological fact that any flood control structure obstructs the natural

working of a river. This change in the colonial policy from maximum to minimum intervention is best encapsulated by the famous report of the 1928 Flood Committee. This committee was constituted in 1927 to inquire into the nature and causes of the devastating floods in Baitarni, Brahmini, and Mahanadi. The report made some subtle observations:

“...the problem that has arisen in Orissa is due, in the main, to the efforts which have been made towards its protection. Every square mile of country from which spill water is excluded means that intensification of floods, means the heading up of water on some one else’s land.... The problem in Orissa is not how to prevent, but how to pass them quickly to sea. And the solutions lies in removing all obstacles which militate against this result.... to continue as at present is merely to pile up a debt which will have to be paid, in distress and calamity at the end.”<sup>47</sup>

The committee proposed that the majority of embankments be gradually phased out. Only those which did not hinder the journey of floodwater to the sea were to be retained. The only ecologically viable, socio-culturally adaptable and economically appropriate policy was to remove all obstacles to nature’s working and thereby improve the drainage of the river. The recommendations of the committee were never, however, implemented as the continuation of the embankment policy served certain

**The policy of embanking rivers proved counter-productive. As experience was gained, it rapidly became apparent that embankments not only clogged drainage systems and magnified flood heights, but also were a substantial drain on the resources of the colonial government.**

vested interests. As rightly put forth by Rohan D,Souza:

“ A century of tampering with the natural drainage and reconfiguring the topography and agrarian production regime to suit exigencies of rule and administration had led to the creation of several ‘protected enclaves’, substantially insulated from flood-spill. These protected zones, surrounded by embankments, were now decisively committed to the continuation of the embankment system as many of them had sunk below the beds of the rivers.<sup>48</sup>”

The construction of embankments persisted due to pulls and pushes from protected enclaves. In addition, those staying in unprotected enclaves and semi-protected areas feared the fury and brunt of floodwater once the construction of embankments stopped, and thus were in favour of the embankment policy. The colonial rulers were thus caught in a whirlpool of various interests as they attempted to undo the flood strategies of the past. When the British left India, there were some 5,280 km of embankments along rivers. Thirty-five hundred kilometres were in the Sunderbans in West Bengal and 1,209 km were along the Mahanadi in Orissa, together they protected a total of about three million ha.<sup>49</sup> Despite the continued construction of embankments, the general consensus until the 1940s was that policy and implementation activities should focus on improving the drainage of rivers rather than on impeding their way by constructing structures.

### Post-Colonial Institutional and Policy Landscapes: Continuity and Change

In post-Partition India, the immediate and delicate mission of central leadership was to keep the country united; in fact, the agenda for integration transcended all other concerns. The construction of the temples of modern India, centrally-planned multi-purpose dams, became a symbol of prestige. Their construction, projected as the harbinger of future development at a time of high expectations, brought political legitimacy to the new leadership in the eyes of the masses. Three years after independence, the First Five-Year Plan (1951-56) emphasised the construction of multi-purpose dams (the Damodar Valley Corporation, the Kosi dam at Barahkshetra, Nepal and the Mahanadi Hirakud dam) not only for controlling floods but also for harnessing floodwaters for hydro-electricity and irrigation. The construction of these projects was also inspired by developments in the West, where the success of project like the Tennessee Valley Authority (TVA) in the US, a front-runner in the flood controlling technology, originated the idea that harnessing river systems for hydro-electricity, irrigation and flood control was necessary step for development of all nations worldwide.

The devastating floods of 1954, particularly all the northern rivers that marooned Bihar, UP, West Bengal and Assam, exposed the limitations of flood control measures, in particular multipurpose

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**The devastating floods of 1954, particularly all the northern rivers that marooned Bihar, UP, West Bengal and Assam, exposed the limitations of flood control measures, in particular multipurpose dams, which were the focal point for implementation during the first Plan. As a result, the Rashtriya Barh Ayog stressed the need for integrated sets of measures.**

dams. Thus, to control the menace of floods a three-phased programme was proposed in the Second Plan (1956-1961) which emphasised both short-term and long-term measures like building of embankments, channel improvements, increasing the level of villages and protection of towns and the construction of dams as long term measures. It was also proposed that Central and State flood control boards be established in order to implement plan activities. In addition, with water as a state subject, the primary responsibility of undertaking flood control measures was given to the State governments. By the end of Third Plan (1961-1966) over 7,000 km of new embankments, 8,700 km of drainage channel, 164 town protection schemes and 4,582 villages raising projects were constructed.<sup>50</sup>

The Fourth Plan (1969-1974), recognising that flood control, drainage and anti-waterlogging works are closely related to irrigation, formulated schemes in an integrated manner so that the measures taken up in one place did not accentuate the problems in neighbouring areas. The Fifth Plan (1974-1978), again shifting emphasis to the raising and strengthening embankments, states: 'first priority will be given to the raising and strengthening embankments and other connected flood protection works'.<sup>51</sup>

In 1976, the Government of India decided to set up the Rashtriya Barh

Ayog (National Flood Commission) (RBA) to evolve a coordinated, integrated and scientific approach to flood control problems in the country and to draw up a national plan fixing priorities for implementation. After conducting a comprehensive analysis of the flood control measures already adopted, RBA, in its report of 1980, stressed the need for implementation of an integrated set of measures, both structural and non-structural, including dams, embankments, flood forecasting and warning. In the absence of any viable protective measures, the commission recommended flood plain zoning, adjusting cropping patterns and raising villages. The report also assessed the area vulnerable to floods as 40 million hectares. Unfortunately, most of the recommendations of the RBA have remained on paper. Little that was agreed upon has been implemented. For instance, the Review of the Sixth Five-Year Plan (1980-1985) clearly indicates that the states have not been accountable for or efficient in implementing the recommendations of RBA. The Working Group on Flood Control for the Tenth Plan (2003-2007) also recommended setting up a new Integrated Flood Management Commission to review the follow-up action taken on the recommendations made by the RBA in 1980.

The Seventh Plan pointed out the poor performance of earlier initiatives and placed emphasis on implementing structural measures. In addition to protecting towns and important installations, it proposed the implementation of anti-erosion

measures to stabilise the benefits from existing schemes. Seventh Plan documents pointed out that the maintenance of flood control works had been hampered due to the inadequate allocation of funds and recommended that states provide adequate budgets for maintenance on the basis of the recommendations of the Eighth Finance Commission.

The Eighth Plan proposed that the government continue making substantial investments in maintaining embankment and flood control works and use maintenance to provide job opportunities. By linking maintenance with employment generation programmes such as the India Jawahar Rozgar Yojana, the twin objectives of flood protection and rural income creation could be fulfilled. In the Eighth Plan schemes for flood proofing including the construction of raised platforms, assured communication systems, drinking water supply systems, post-flood relief systems and so on were taken up in North Bihar. The Eighth Plan also recommended that flood-proofing measures be implemented in areas which suffered from repeated flood damage. This scheme continued in the ninth plan and in the tenth plans. Expansion of the scheme to other flood-affected areas has been proposed and is currently under consideration.

In the Ninth Plan (1997-2001), it was observed that, in addition to the progress made in implementing structural flood protection measures, flood forecasting and warning systems had played a great role in mitigating

the loss of life and enabling the protection of movable property. As a result, resources and attention were shifted toward strengthening these systems. Now there are 159 flood, 134 level and 25 inflow forecasting stations on major dams and barrages. This represents the beginning of a gradual shift away from purely structural measures toward other forms of non-structural mitigation. This change was also accompanied by recommendations for flood plain zoning and other, similar activities to reduce vulnerability. The Tenth Plan highlighted the limited success attained through non-structural measures and emphasised the apathy within the states with regard to flood plain zoning legislation. It also emphasised the need to develop long-term and permanent solutions to flooding through a variety of measures, including constructing storage, raising villages, modifying cropping patterns (sowing crops which can tolerate waterlogging), setting up a nationwide network of communication, forecasting and forewarning systems, and ensuring people's participation in the maintenance of embankments. Although the 10th Plan contained both structural and non-structural elements, the focus remained dominantly structural and focused toward flood control.

According to official statistics, the flood management measures undertaken so far have provided a reasonable degree of protection to an area of 15.81 million ha across India. There has been little attempt, however,

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**The Ninth Five-Year plan saw the beginning of a gradual shift away from purely structural measures toward other forms of non-structural mitigation.**

to evaluate whether or not this has actually reduced people’s vulnerability to flood hazards or the scale of vulnerability and marginalisation among those affected by floods. The flood policy situation is also complicated by a lack of clarity regarding ‘who decides what for whom?’ In many cases it is unclear who the policy makers at the central and state levels are. Areas of responsibility and degrees of accountability are unclear. Since flood management is under state control, flood control schemes are planned, funded and executed by state governments themselves, using their own resources and according to their own priorities. The formal role of the central government is to render technical assistance that is catalytic and supportive in nature. The central institutions involved include the Central Water Commission, the Ganga Flood Control Board and the Brahmaputra Board. At the state level the institutions responsible for planning and implementation of flood protection schemes are the state water resource ministry, the relief and rehabilitation department and the irrigation departments. In many, if not most, cases the allocation of responsibility among these three agencies within each state and between states and the central government is both highly politicised and far from clear. The brief assessment of Bihar’s policy response to floods provided below reveals how the broader and deeper geo-political dynamics of centre-state relations in the Indian federal system continue to

influence both official perceptions of and policies towards flood management.

### State Responses to Floods: Perspectives from Bihar

In spite of repeated acknowledgements both inside and outside official circles that there are serious limitations with the structural paradigm of constructing embankments and levees, the shift towards non-structural approaches has been slow and hesitant. A total of 3,465 km of embankments have been constructed along rivers in Bihar. Parallel to the embankments, a massive network of roads and railway lines were built east to west, cutting across and disrupting natural drainage systems. According to the Barh Mukti Abhyan, investment in the construction and maintenance of embankments up to 1989-90 totalled Rs 5,300 million. Since 1990-1991, the government has constructed only 11 km of embankment but it has spent approximately Rs 2,700 million rupees on embankment maintenance. Between 1955, when flood control works was initiated, and 1998 the Bihar government has invested approximately 7,460 million rupees on the construction and maintenance of 3,454 km of embankments.<sup>52</sup>

Despite this massive investment, Bihar, the most flood-affected state in India, accounts for 56.5% of the nation’s flood victims.<sup>53</sup> According to the Tenth Year Plan (2002-2007), thirty out of the thirty-eight districts of Bihar are flood-prone. The flood-prone area of Bihar has increased from 4.2 million ha to

In many, if not most, cases the allocation of responsibility among key agencies within each state and between states and the central government is both highly politicised and far from clear.

**Table 3: State-wise Physical Achievement of Works Under Flood Management (as of March 3/2000)**

Sl. No.	State/ UT's	Length (km)		Towns/Village (Nos.)		Area benefited in ha (10 <sup>4</sup> )
		Embankment	Drainage Channels	Protection Works	Protected	
1.	Andhra Pradesh	2,100	13,569	68	21	0.54
2.	Arunachal Pradesh	2	-	-	-	-
3.	Assam	4,454	851	660	-	1.6357
4.	Bihar	3,454	365	47	-	2.949
5.	Goa	10	12	4	6	0.0001
6.	Gujarat	104.12	271	805	30	0.4827
7.	Haryana	1,144	4,385	448	98	2.0
8.	Himachal Pradesh	58	11	-	-	0.0097
9.	Jammu & Kashmir	230	14	12	5	0.2173
10.	Karnataka	-	-	-	-	0.0008
11.	Kerala	116.7	29	4	6	0.0555
12.	Madhya Pradesh	26	-	37	-	0.0040
13.	Maharashtra	26	-	26	-	0.0010
14.	Manipur	360	126	1	1	0.130
15.	Meghalaya	112	-	8	2	0.0011
16.	Mizoram	1	1	-	-	-
17.	Nagaland	-	-	-	-	-
18.	Orissa	6,515	131	14	29	0.4800
19.	Punjab	1,370	6,622	3	-	3.19
20.	Rajasthan	145	197	25	-	0.0816
21.	Sikkim	7	12	6	-	0.002
22.	Tamil Nadu	87	19	11	4	0.1220
23.	Tripura	133.30	94	64	-	0.0251
24.	Uttar Pradesh	2,681	3,593	48	4,511	1.599
25.	West Bengal	10,350	7,129	-	-	2.2005
26.	A&N Island	-	-	-	-	-
27.	Chandigarh	-	-	-	-	-
28.	Dadra & Nagar Haveli	-	-	-	-	-
29.	Daman & Diu	-	-	-	-	-
30.	Delhi	83	453	-	-	0.0780
31.	Lakshadweep	-	-	-	-	-
32.	Pondicherry	61	20	2,337	-	0.004
	<b>Total</b>	<b>33,630.12</b>	<b>37,904</b>		<b>4,713</b>	<b>15.8091</b>

Note: These are the figures as furnished by the State Government. Wherever there are significant changes noticed with reference to 1993 and 2000, the States have been asked to reconfirm these figures.

Source: Ministry of Water Resources (2000)

6.9 million ha (Ganga Flood Control Commission, Master Plan, Vol. I).<sup>54</sup> Seventeen per cent (nine million ha) of Bihar's land area is permanently waterlogged. According to the report of the Eleventh Finance Commission of Bihar in 1999, flood-related damage

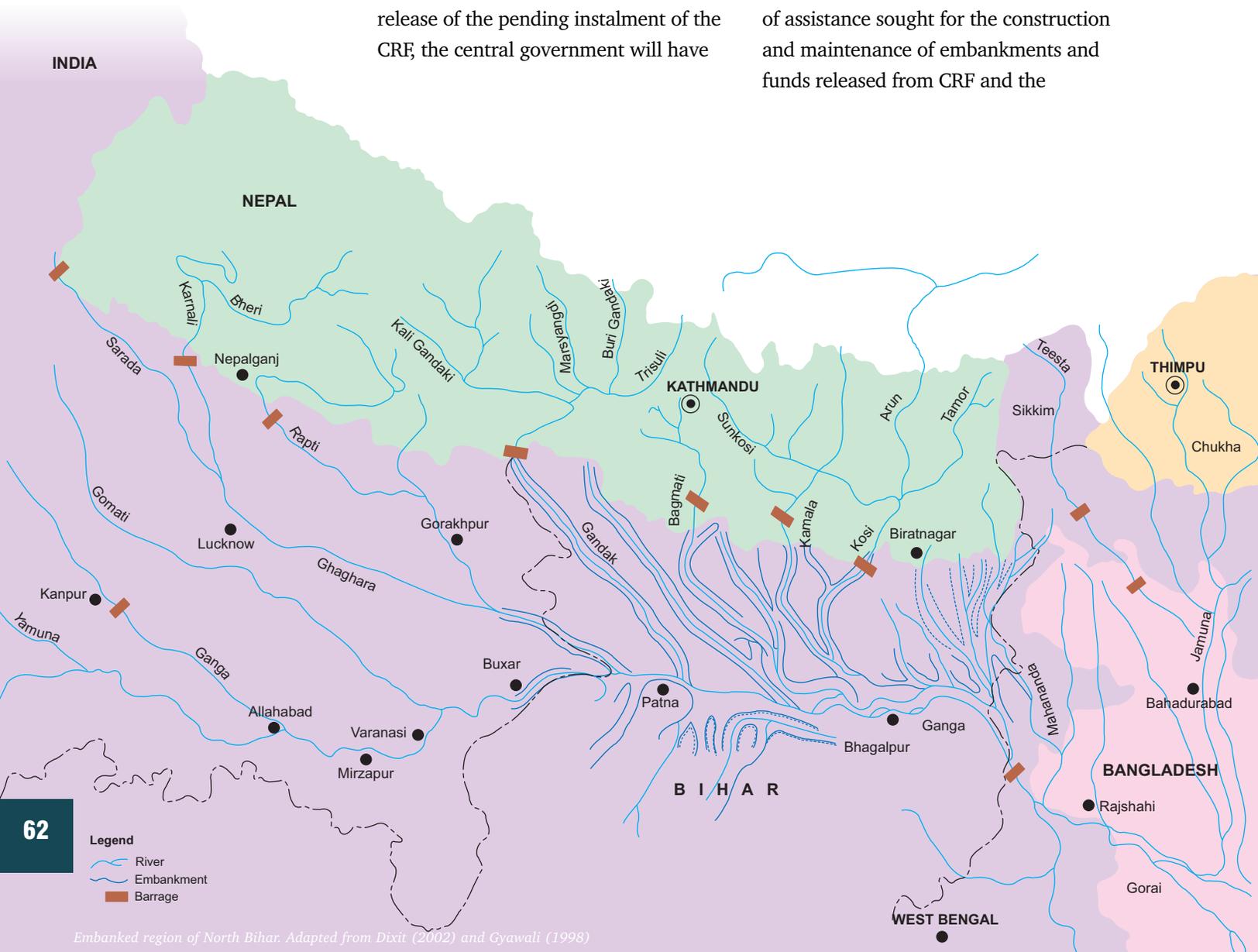
rose by 54 times during Laloo Prasad Yadav's tenure, from Rs 9.49 million in 1989-1990 to Rs 5,147.8 million in 1998-1999.<sup>55</sup> In 2001 flooding in Bihar covered 24 districts, affecting more than 600,000 people, 11,000 cattle and inundating 1,700 thousand ha of land.<sup>56</sup>

As damages have increased, so has expenditure on rehabilitation. The share of the central government's Calamity Relief Fund (CRF) released to the state of Bihar was IRs 337.9 million during the year 1999-2000; IRs 502.2 million in 2000-2001 and IRs 263.65 million in 2001-2002. Additional assistance to the tune of IRs 381.8 million in 1999-2000 and 296.7 million in 2000-01 was provided under the National Fund For Calamity Relief (NFCR)/National Calamity Contingency Fund. Once the government of Bihar has completed the formalities for the release of the pending instalment of the CRF, the central government will have

provided Bihar a total of IRs 540.5 million of its second instalment of CRF support for the year 2001-02 and of the first instalment of additional funds for 2003.<sup>57</sup> These figures suggest that the central government alone will have spent at least IRs 2,322.75 million on flood relief in Bihar from 1999 to 2003. If the amounts spent by the Bihar government are added, the total probably far exceeds the amount invested in the maintenance of embankments over the same period.

The mismatch between the total amount of assistance sought for the construction and maintenance of embankments and funds released from CRF and the

**The shift towards non-structural approaches has been slow and hesitant.**



damage reported raises serious questions regarding the approaches to flood management of the state and central governments. As is clear from its Tenth Five-Year Plan 2002-2007, the state government of Bihar continues to frame solutions to the problem of flooding largely in terms of the viability and vitality of structural measures. According to the plan, long-term structural solutions to flooding lie in the construction of dams in Nepal, while short-term measures focus primarily on building embankments along the rivers of Bihar. The Government of Bihar's Tenth Five Year Plan (2002-2007) illustrates this well. According to it:

“The long-term solution of flood problem in Bihar lies in the provision of reservoirs in the upper reach of main rivers and their tributaries. Unfortunately, most of these rivers originate in Nepal and flow through it for the considerable length before entering Bihar. All suitable dam sites fall in that country. Only with the sincere co-operation of the HMG Nepal and Central Government, construction of dams in Nepal territory is possible. Sites on the tributaries of Kosi river have been investigated and a high dam at Barahkshetra is proposed which would moderate the maximum probable flood of 42,475 cumecs (15 lakh cusecs) to a flood of 14,000 cumecs (5 lakh cusecs) at Barahkshetra. It will also trap the bulk of coarse and medium silt carried by the river which in turn help stabilise the river and reduce the meandering/ braiding tendency of the river.

However, before such measures come into reality, the State will have to depend on short-term measures including the construction and maintenance of embankments along the rivers. Flood management works so far implemented comprise construction and maintenance of 3,454 km. of embankments, revetment in selected portions of river banks, land spurs-367 nos. (284 in Kosi, 30 in Mahananda, 18 in Ganga, and 35 in Gandak) and such others flood protection works.”

Despite the failure of all embankments to control floods, government authorities continue to rely on them as their primary flood control measure. The government of Bihar has, for example, submitted a list of 19 schemes, including five for anti-erosion works and 14 for raising and strengthening or constructing embankments to the Ganga Flood Control Commission. The total estimated cost of their implementation is about Rs 542 crores (5,420 million rupees).<sup>58</sup> The growing size of flood-prone areas, the massive expenditure on flood control measures, the mounting costs of flood damage and the continued expenditure on flood relief raises important questions regarding the government's approaches to flood management. The official perception of the causes and the consequences of floods must be questioned, as must the effectiveness of structural measures, especially dams and embankments. In Nepal, less than 50% of precipitation falls above locations in the Himalaya where dams could be constructed. It is, as a result,

**The state government of Bihar continues to frame solutions to the problem of flooding largely in terms of the viability and vitality of structural measures.**

physically impossible to fully control flooding by constructing dams there. Overall, state investments in embankments, drainage and protective works have been highly skewed. Bihar, for example, has constructed 3,454 km of embankments but only 365 km of drainage canals, while UP in contrast, has constructed 3,593 km of drainage canals and only 2,681 km of embankments.<sup>59</sup> No villages in Bihar have been raised but 4,511 in Uttar Pradesh have been. The total investments in flood protection across India are summarised in the table 4.

raised, they explained floods often drained quickly and deposited a thin fertility enhancing layer of silt on their fields. Now, many villages face serious problems: Where flood flows are concentrated, sand casting prolonged, flooding and waterlogging plague villages. In places where embankments reduce shallow flooding groundwater recharge is limited and drought-like impacts lower soil moisture. In brief, villagers often see themselves as caught in a flood/drought cycle, with far-reaching implications for agriculture, livelihoods, health and migration flows.

**Despite the failure of embankments to control floods, government authorities continue to rely on them as their primary flood control measure.**

### Village Perspectives

The official understanding of flood issues, as revealed through government policies and pronouncements, fails to acknowledge the experiences of communities affected by floods or the grass root expectations vis-à-vis government agencies responsible for flood mitigation and management. Insights garnered from field reports on sixteen villages in Bihar and Uttar Pradesh located in the Rapti/Rohini River basin of Uttar Pradesh and the Bagmati River basin of Bihar, reveal for example, a far more complex picture of ground reality than perhaps assumed by policy-makers.

Interviews conducted as part of this study, reveal that many residents in the villages of both Bihar and UP perceive floods as a natural-social phenomenon and feel that the overall condition of their villages was better before embankments were constructed than it is now. Before embankments were

### Government Flood and Drought Response Synthesis

The response of governments to floods and droughts are remarkably alike. While Nepal's plans remain dominantly on paper, they are broadly similar to those in India. In both cases investment strategies focus on structures and other physical interventions designed to increase control over water availability and flow. In the case of droughts this investment emphasises water harvesting and to a lesser extent, improving vegetative cover in watersheds. These investments are intended primarily to increase the physical availability of water during dry periods. In the case of floods, most investments are directed toward the construction and maintenance of embankments and other flood control structures. Both floods and droughts are, at least in the practical sense of investment, seen as external events that can be controlled through the construction of physical structures. Concepts of flood and

**Table 4: State-wise list of Central Assistance Released from National Fund for Calamity Relief/ National Calamity Contingency Fund for weather-related calamities (1999-2000 to 2001-2002)**

State	Calamity	Assistance Released IRs (10 <sup>5</sup> )
<b>1999-2000</b>		
Andhra Pradesh	Drought	753.6
Bihar	Flood/cyclone	381.8
Gujarat	Drought	545.8
Jammu and Kashmir	Drought	734.2
Karnataka	Drought/flood	170.9
Madhya Pradesh	Drought/flood	388.6
Manipur	Drought	49.3
Mizoram	Drought	60.0
Orissa	Drought/cyclones	8,281.5
Rajasthan	Drought	1,029.3
Tripura	Drought	53.4
West Bengal	Flood	295.2
<b>Total</b>		<b>12,743.6</b>
<b>2000-2001</b>		
Arunachal Pradesh	Flash floods	20.0
Bihar	Rains/floods	296.7
Chhattisgarh	Drought	400.0
Gujarat	Drought	850.0
Himachal Pradesh	Rains/floods	82.9
Madhya Pradesh	Drought	350.0
Meghalaya	Cyclone winds	10.0
Orissa	Drought	350.0
Rajasthan	Drought	850.0
West Bengal	Rains/floods	1,032.5
<b>Total</b>		<b>4,242.1</b>
<b>2001-2002</b>		
Andhra Pradesh	Rains/floods	304.4
Chhattisgarh	Drought	189.4
	Floods	239.4
Gujarat	Drought	270.0
Himachal Pradesh	Flash floods	250.0
	Rains/floods	175.0
	Drought	189.8
Jammu and Kashmir	Drought	232.0
Madhya Pradesh	Drought	227.2
Orissa	Drought	146.2
	Floods	1000.0
Rajasthan	Drought	789.7
<b>Total</b>		<b>4,013.1</b>
<b>Total 1999-2002</b>		<b>20,998.8</b>

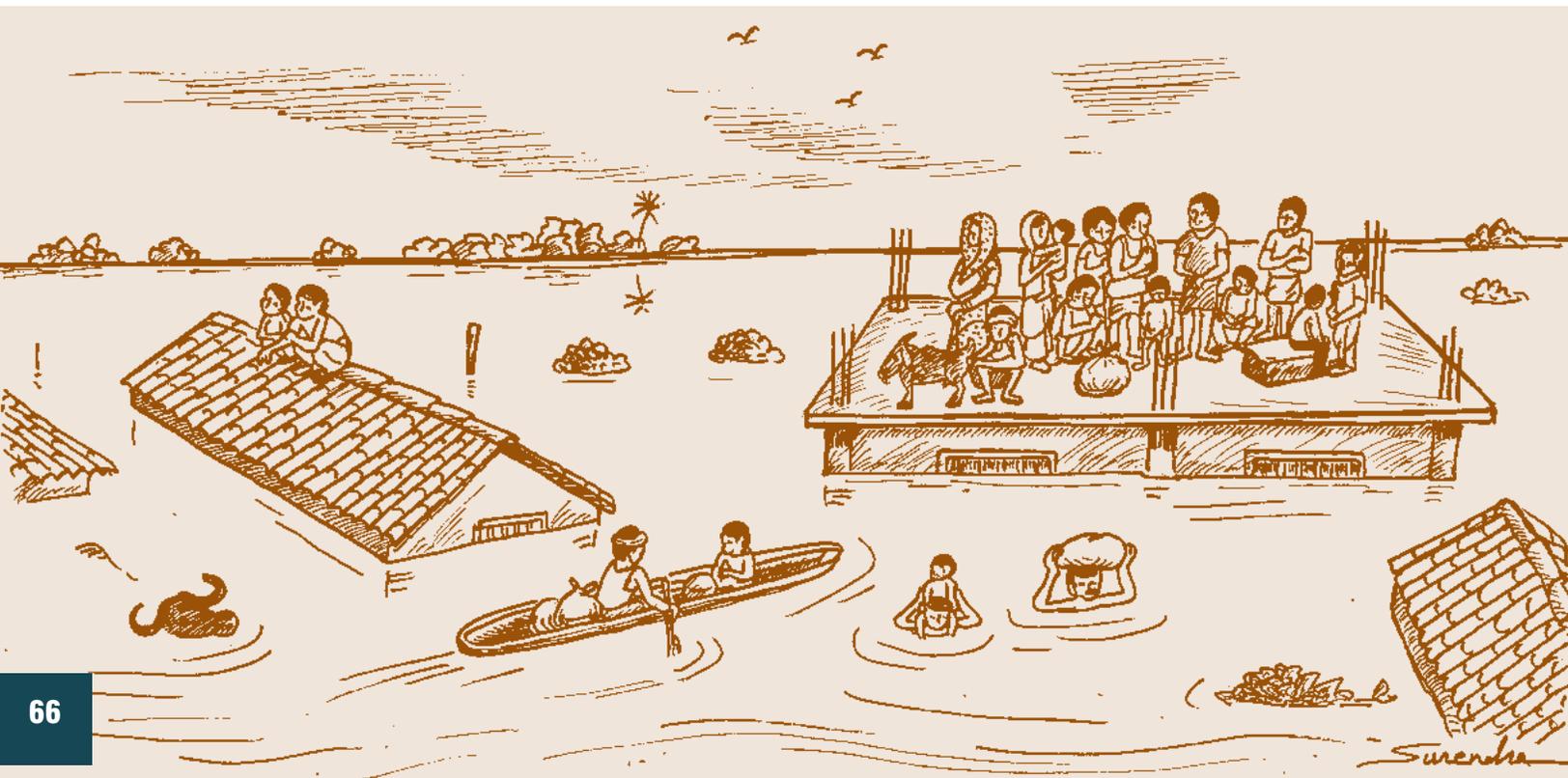
Source: Lok Sabha Unstarred Question No. 3324, dated 06.08.2002 - www.IndiaStat.com

drought-proofing exist and do include the recognition of wide measures related to the vulnerability of livelihoods. Translating such concepts into governmental programmes that actually direct significant investment into something other than the construction of water control structures has, not however, occurred on a widespread basis.<sup>60</sup> As the guidelines for watershed project investment allocation present in table 5 clearly indicate, even in watershed development activities most funds are allocated for hardware and relatively little is spent on the development of social capital or livelihood-focused activities.

Investments in water control structures, whatever their relative costs and benefits, have not ameliorated the impacts of floods and droughts. In fact,

as early insights from colonial efforts toward flood control indicate, conventional courses of action often increase long-term vulnerability. Whatever the specific cause, expenditures on flood and drought disaster relief through central mechanisms such as the Calamity Relief (CR) and the National Calamity Contingency Fund (NCCF) and at the state level have been increasing. With the exception of the Gujarat earthquake, virtually all funds spent on disaster mitigation are for floods, droughts and other climate-related disasters. Over the period from 1999 to 2002, the total expenditure Indian resources on disaster relief was over Rs 20,999 million. Most of these funds have been spent on immediate humanitarian relief and, in the case of droughts, civil works programmes

**Both floods and droughts are, at least in terms of investment, seen as external events to be controlled through physical structures.**



designed to provide immediate employment and income. Such expenditures, however, do not reduce vulnerability to future droughts or floods in any substantive manner.

Aside from governmental interventions to reduce flood and drought impacts, the primary organised response at a societal level has been through NGOs, which have played a major role in drought and, to a lesser extent, flood mitigation and relief activities. Their roles are explored in detail below.

### Responses to Floods and Droughts by NGOs

Across India and Nepal, NGOs have played a major role in flood and drought relief and mitigation activities, largely by assuming responsibility for implementing governmental relief and mitigation programmes. In the case of drought NGOs have, for example, served as the interface between the government and local communities for implementing many watershed development programmes. These programmes invest substantial amounts of government funds in what are in effect, drought mitigation measures, as part of normal development investment. As documented in the discussion of governmental roles in drought mitigation above, in Rajasthan alone approximately Rs 8,534.9 million have been invested in watershed activities. NGOs' lead role in watershed programmes has contributed to the sustained presence of NGO activities in many rural areas. No parallel programmes of watershed investment exist in flood-prone areas

Table 5: Fund Allocation Guidelines: Watershed Development

S. No.	Activities	Percentage
i)	Watershed treatment/development works/activities (hardware)	80
ii)	Watershed community organisation including entry point activities	5
iii)	Training	5
iv)	Administrative overheads	10
	<b>Total</b>	<b>100</b>

Source: Ministry of Rural Development (2001)

where most protective measures, such as the construction of embankments, are implemented directly by government agencies. NGOs are, however, often involved in long-term development activities in flood-affected regions. They have also been at the forefront in the delivery of flood and drought relief. In the case of drought relief, NGOs often run rural employment schemes and are responsible for organising watershed treatment schemes and constructing water harvesting structures financed through government and donor relief programmes. Where floods are concerned, NGOs are active in the delivery of food, medical and other services for the affected populations.

A complete review of NGO activities in response to floods and droughts is beyond the scope of this report. Our main focus here is on the points where such activities substantively differ from or extend beyond the focus and types of activities currently being implemented by the government. We focus on the following three:

1. The role of asset building and watershed programmes in drought mitigation;

**Across India and Nepal, NGOs have played a major role in flood and drought relief and mitigation activities, largely by assuming responsibility for implementing governmental programmes.**

2. Local activities to reduce flood vulnerability; and
3. The links between these activities and the growing debate in NGO circles on appropriate approaches to disaster response.

Now, to the initial focus on asset building and drought mitigation.

### Asset Building and Watershed Development Programmes in Drought Mitigation

Sustaining the livelihoods of an increasing population in the drought-prone arid and semi-arid regions of India, where natural resources are highly degraded, is an enormous challenge. Lack of precipitation in many regions of Gujarat and Rajasthan, two states that were severely affected by drought in the year 2000, led to massive crop failures and forced people to migrate to other areas in search of livelihoods. In the midst of this drought-stricken landscape, however, there are locations where the daily lives of certain communities appear to be relatively undisturbed. Often these are communities that have undertaken water harvesting and watershed management activities, which have enhanced their livelihood asset base. This asset base primarily comprised of five types of capital – social, natural, physical, financial and institutional – has helped them develop resilience to drought.

This section synthesises the findings of the report of Winrock International India (WII) entitled ‘Learning Enhancement Exercise on Rainwater

Harvesting’. The project was carried out with support from Ford Foundation under its Community Asset Building Programme.<sup>61</sup> The project areas selected for the purpose of this review included the areas of interventions of four partner NGOs: SKTGSM and SEWA of Gujarat and PRADAN and Seva Mandir of Rajasthan. All the areas witnessed three to four consecutive years of drought, starting from 1999.

The four cases offer an important opportunity to understand what kind of investments made in specific situations would produce desirable impacts in terms of drought proofing, livelihood augmentation and gender and social equity.

Methodologically, the exercise involved reviewing literature related to water harvesting and watershed activities, and fieldwork in the single ‘best’ village from each of the four intervention areas. This field work was performed using participatory research techniques involving focus group discussions and interviews of key informants, followed by debriefing sessions with the partner NGOs. The intervention areas of these NGOs were diverse in their socio-economic and natural resource systems both hydrological and geo-hydrological. Table 6 provides an overview of the selected intervention areas of the four NGOs chosen.

As can be seen from the above table, the period of intervention in three out of the four partner NGOs was eight to nine years. Seva Mandir, at 17 years, was an exception. Three areas of

**NGOs’ lead role in watershed programmes has contributed to the sustained presence of NGO activities in many rural areas.**

Table 6: NGO Interventions in Watershed Management

NGO (year of establishment)/year of initiation of water harvesting and watershed activities	Ecological zone (arid/semi arid)	Average annual rainfall (mm)	Occurrence of drought
Shree Kundla Taluka Gram Seva Mandal (SKTGSM), Savarkundla, Amreli, Gujarat (1955/1994)	Referred to as the Saurashtra region; Semi-arid area	533 (1990-2002); During 1990-2002, seven years were below normal rainfall, while only in three years (1994, 1998 and 2001) the rainfall was more than 30% of the average	The last three years 2000-2003 (summer) were drought-affected
Self Employed Women's Association (SEWA), Ahmedabad, Gujarat (1972/1995)	Santalpur taluka of Patan District located in Northern part of the state; Arid area	398 (1986-2002)	The drought has continued in the project area for the third successive year from 2000
Professional Assistance for Development Action (PRADAN), Alwar, Rajasthan (1983/1994)	Kishangarh Bas block of Alwar District located in North-eastern region of the state; Semi-arid area	650	Drought from very severe to light intensity has occurred in 45 years during 1901-1999. The drought of summer 2003 is the fourth
Seva Mandir, Udaipur, Rajasthan (1966/1986)	Jhadol block of Udaipur District located in the southern region of the state; Semi-arid area	614	Drought from very severe to light intensity has occurred in 44 years during 1901-2002. The drought of summer 2003 was an extension of drought of 2000

intervention were in hard rock regions with groundwater conditions ranging from moderate to poor. Though groundwater availability in the fourth project area that of SEWA, was good, alluvial formations, which make the water extremely saline, prevented it from being of much benefit. Variations across the four partners were also evident in the profiles of the target communities; they ranged from significantly tribal to non-tribal and from relatively homogeneous to multi-caste composition. The diversity in caste structures reflected diversity in livelihood options as well.

One major difference between the partners in the two respective states was their source of funding. The NGOs in Gujarat receive government funding, while those in Rajasthan receive foreign

aid. This difference determined the manner in which they provided support to communities for creating social assets. All four received supplemental support from the Ford Foundation to develop social capital.

Other elements of diversity across intervention areas involved the type of interventions and the distribution of investments to the development of private, group, and community assets. Investments in private assets included farm bunds and levelling on private land; investments in group assets consisted of building checkdams, *paals* and anicuts which benefited a small group in the vicinity of the structure. Investments in community assets comprised the treatment of *panchayat* land by fencing, plantation, the construction of loose stone checkdams

**Sustaining the livelihoods of an increasing population in the drought-prone arid and semi-arid regions of India where natural resources are highly degraded is an enormous challenge.**

and *nala* plug and the rehabilitation of tanks (in which case the cost is incremental in nature) which benefited the village community as a whole.

In the next few sections we provide an overview of the investments made by partner NGOs in natural, social (including institutional) and human capital prior to drought periods along with the type and the extent of the returns from these investments during drought years.

**Natural capital - investments and returns:**

The proportion of watershed investments in private, group, and community assets, and their returns varied greatly across partners, as shown in the table 7.

The figures indicate that in terms of economic viability, the performance of PRADAN (Ratakhard) was the best. Net annual returns from agriculture for example, reached as high as 80% of the total project investment. The fact that all this investment was non-incremental (resting completely on new structures and not involving the rehabilitation of existing structures) makes the figures even more impressive in comparison to those for interventions in other villages. Though the net annual return as a percentage of total investment for PRADAN (Ratakhard) is higher than it is for SKTGSM (Dedakdi), the net annual return is one-third of that achieved in SKTGSM (Dedakdi). In both cases, the high proportion of benefits is explained partly by

**Support involved building private, group and community assets.**

Table 7 : **Watershed Investments and Returns**

Particulars	SKTGSM (Dedakdi)	SEWA (Barara)	PRADAN (Ratakhard)	Seva Mandir (Shyampura)
Area benefited due to treatment (ha)	480	451	157	160
Total area of village (ha)	1,200	1,254	893	267
Treated area as % of total area of village	40	36	18	60
Investment in community assets IRs (10 <sup>5</sup> ) (%)	0.32 (1)	3.84 (23)	1.36 (21)	4.88 (27)
Investment in group assets IRs (10 <sup>5</sup> ) (%)	23.91 (89)	0 (0)	4.08 (61)	11.38 (62)
Investment in private assets IRs (10 <sup>5</sup> ) (%)	2.57 (10)	12.9 (77)	1.36 (18)	2 (11)
Total investments through project IRs (10 <sup>5</sup> ) (%)	26.8	16.74 (100)	6.68 (100)	18.26 (100)
Private investment triggered by project IRs (10 <sup>5</sup> ) (%)	52.5 (196)	0 (0)	12.6 (189)	8.5 (47)
Total of project and private investments IRs (10 <sup>5</sup> )	79.3	16.7	19.4	26.7
Net annual returns from Agriculture	18	8.3	5.4	5.7
Net annual returns as percentage of total project investment (%)	67.16	49.76	80.15	31.27
Net annual return as percentage of total investment (project and private) (%)	22.70	49.76	28.09	21.34
Total households in the village (no.)	125	300	256	126
Net annual return per household IRs	14,400.0	2,776.7	2,128.9	4,531.7
Project investment per household IRs	21,440.0	5,580.0	2,656.3	14,492.1
Ratio of annual return per household to total project investment per household <i>in one year</i>	0.7	0.5	0.8	0.3

Note: Figures in brackets show percentage to total investments through project

additional private investment in groundwater development and utilisation that was triggered by the project when farmers realised, after one or two monsoons, that groundwater availability had improved. In both cases the additional investment was almost two times the original project investment. When one compares the net annual return as a percentage of total investment (including both project and private investments), the difference between the four initiatives looks less significant. Looking at the ratio of net annual return per household to total project investment per household, PRADAN (Ratakhard) once again appears as the leader with 0.8. It is followed closely by SKTGSM with 0.7, while Seva Mandir comes the rear with 0.3. It is important to recognise, however, that such benefits are highly dependent on the ecological endowments of an area. Furthermore, as mentioned earlier, investments in watershed projects are justified not just by their economics but also by non-tangible social benefits such as drought-proofing and social equity. This aspect is discussed in the next section.

As the proportion of investments made in community assets increases, perceptions of social equity and of the inclusion of weaker sections of the community also increases. In the sample areas of interventions, the proportion of project investments in community assets (such as village tanks and soil and water conservation structures viz *nala* plugs, trenches, loose stone checkdams on

village commons) was the highest in the case of Seva Mandir (27%) followed by SEWA (23%) and PRADAN (20%) (See table 7). Investment in community assets was negligible in the case of SKTGSM. If private investments triggered by the project are induced, the proportion of investment in community assets becomes insignificant for both PRADAN and SKTGSM. SEWA leads with 22.94% and is followed by Seva Mandir with 18.24%. PRADAN and SKTGSM, focused on individual farms through the creation of common property assets among small groups of farmers. Seva Mandir was most successful in ensuring that different social groups, hamlets, and gender are represented in the committees governing watershed investments. It was also the only agency formally monitoring institutional performance from the viewpoint of long-term sustainability. In the case of both SEWA and Seva Mandir, the watershed committees evolved into *gram vikas* committees with a larger mandate and more responsibilities for coordinating long-term development initiatives in the villages.

As the proportion of investments made in community assets increases, perceptions of social equity and of the inclusion of weaker sections of the community increases.



Dried lake in Rajasthan

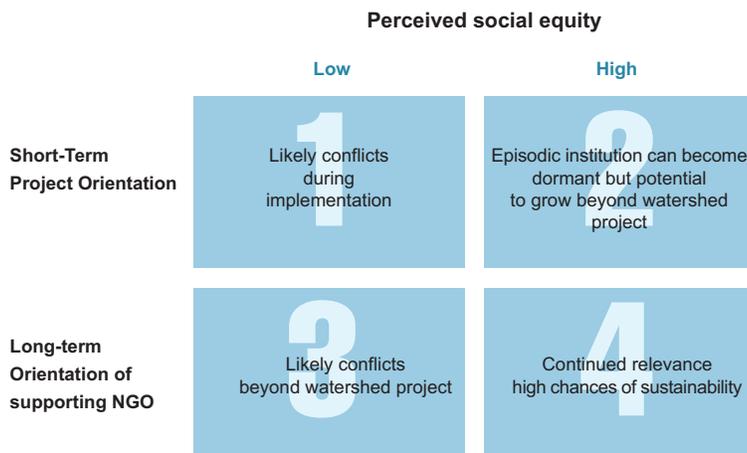
**Social capital - investments and a multitude of benefits:** The figure below illustrates the relationship between social equity, short-term project orientation and the sustainability of the institutions created. Perceptions that social equity is low and a short-term project orientation undermine the sustainability of institutions. When the perception of equity is high (cell 2) but projects have a short-term orientation, institutions are ephemeral and unless they develop leadership and vision which takes them on to new objectives beyond watershed development, they are likely to become dormant or disintegrate after the project is over. The best chances for sustainability are when all stakeholder groups are satisfied with their roles and responsibilities and their potential shares in the benefits and when both the facilitating agency as well as the concerned CBO begin to develop a long-term developmental orientation (cell 4). Low levels of equity combined with a short-term project orientation

tend to lead to implementation conflicts, while low levels of equity and a long-term focus lead to other forms of conflict.

Variations in the orientation of partners towards watershed development programmes were observed. For SEWA and Seva Mandir, watershed activities were part of their long-term strategy of rural development in project villages. In the sample cases, the committees in Savarkundla (initiated by SKTGSM) and the isolated watershed committees of Alwar (initiated by PRADAN) could be classified as episodic institutions as they performed well during the project period but began to lose direction once the project was over. In contrast, the committees promoted by SEWA in Santalpur and those promoted by Seva Mandir in Udaipur, and the 10 committees in Alwar that became federated, remained active and purposeful beyond the durations of the watershed projects. In fact, with the adoption of increasingly wide responsibilities, the committees in both Santalpur and Udaipur were gradually converted into gram *vikas* committees with a large developmental mandate.

**Investments in watershed projects are justified not just by their economics but also by non-tangible social benefits such as drought-proofing and social equity.**

Figure 11: Variables Affecting Institutional Sustainability



A key point, emerging from this discussion is that the development of human and social capital in the form of perceived social equity and the sustainability of institutions is critical for addressing access-equity and the sustainability of natural assets. Only when the institutions created in the context of a project are able to move beyond short-term objectives and expand their range of activities do they

remain present and viable as points of social organisation for resource management and drought mitigation in future years. The ability to achieve this was closely connected to the nature of the NGO support. In all cases, the long-standing presence of NGOs in the area prior to involvement in watershed projects created a feeling of supported credibility and the ability to provide long-term support. All four partner organisations enjoyed the credibility, which allowed them to enjoy good rapport with the local communities and contributed to the development of social capital. This established presence enabled traditionally ‘voiceless’ groups to participate effectively. In the project areas of SEWA, Seva Mandir and PRADAN, for example, women gained enough freedom to be able to articulate their concerns at *panchayats* and watershed committees.

**Human capital - Investments and returns:**

The experience gained over recent decades through work on common property institutions, indicates that institutional sustainability depends upon, among other things, creating broad-based leadership, securing financial sustainability, building capacities at all levels and adopting democratic values and principles of governance. These steps require long-term and concerted investment in human capital. At least two of the NGOs reviewed by WINROCK Seva Mandir and SEWA were attempting this. It is interesting to note the difference in funding for hardware (the construction of structures fostering the development of natural assets)

activities and software (the building of capacities leading to development of human capital) across all the four partners. For the Rajasthan partners, funding for hardware activities was foreign aid, while for the Gujarat partners it was the government. This distinction is important since expenditure is heavily skewed towards hardware in the case of government funding.

**Drought coping and livelihood security:**

*Drought coping refers to the measures taken by communities in the short run to survive the scarcity of food, fodder and water caused by a drought.*

*Livelihood security refers to the augmentation of livelihood options for local people in the long run. These could either be through increases in conventional options (e.g., expansion or intensification of agriculture and animal husbandry) or through non-conventional options.*

An increase in livelihood options results in better drought coping especially if they are not based on land-based activities and can be relied on as sources of income even during periods of drought. Because the four partner NGOs were involved in other interventions beyond watershed development to augment the livelihood options of the local communities, there was a need to separate the impacts of the two types of interventions and also to look at them together to see the total impact in a given region.

The source of drought proofing, whether watershed treatment or the generation

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**The best chances for sustainability are when all stakeholder groups are satisfied with their roles and responsibilities and their potential shares in the benefits and when both the facilitating agency as well as the concerned community-based organization to develop a long-term developmental orientation.**

of alternative livelihood options was mapped on the basis of the data available as shown in the figure 12.

The figure indicates that in the case of PRADAN the major contribution to drought proofing was watershed treatment while in the case of SEWA it was through its livelihood interventions. PRADAN has also started promoting dairy cooperatives for women in a major way. Seva Mandir and SKTGSM have made some efforts at developing alternative livelihood options but these are in the nascent stage (e.g., making soap from *ratanjyote* and cultivating *safed musli* in the case of Seva Mandir and manufacturing bio-pesticides in the case of SKTGSM).

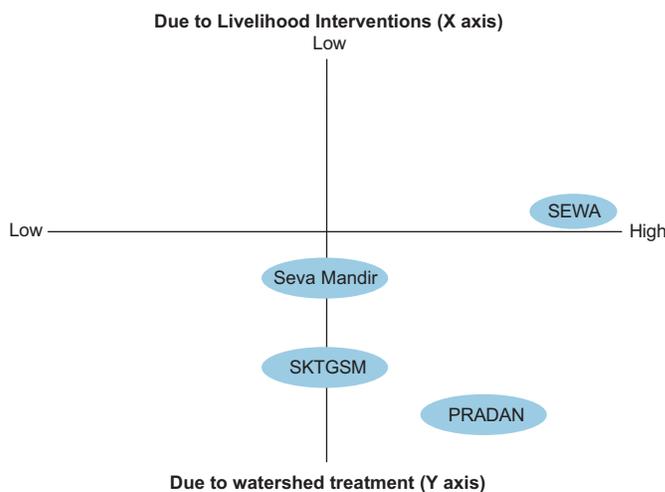
The degree to which watershed programmes improve the ability of communities to cope with drought depends on the extent of surface and groundwater storage capacity created and the strength of local institutions to

manage equitable and efficient use of this resource.

The drought-coping capacity in the rural agricultural areas where the NGOs are working depends on *grain, fodder and water security*. Watershed interventions undertaken in the areas reviewed have been successful in providing security although the degree varies in each region depending on its ecological endowments. In Alwar, for instance, the groundwater recharge in a good year is sufficient to provide the people in the treated hamlet with drought-proofing for the next four years, even if the rains are poor in those years. In Barara, a village in Santalpur, the surface water collected in a tank had a catchment area covering several villages and hence the water lasted even during the severest of droughts. Shepherds and wild animals came to this water hole when all other village ponds in the area were dry. However, when water failed to suffice for grain cultivation during the third consecutive year of drought, people had to rely on the non-farm livelihood options introduced by SEWA, including gum collection, *bharatkam*, salt-making through cooperatives and so on. In most of the semi-arid regions studied, including Alwar and Udaipur, the first option during a drought was to shift the focus from agriculture to animal husbandry. Non-productive animals were sold, often at just one-third of the normal price, and the entire effort of the family was placed on feeding the remaining productive animals even if it meant purchasing fodder at exorbitant rates. This strategy was common to watershed project and control villages

**Drought coping refers to the measures taken by communities in the short run to survive the scarcity of food, fodder and water caused by a drought. Livelihood security refers to the augmentation of livelihood options for local people in the long run.**

Figure 12: Mapping Sources of Drought Proofing



alike. Locations where projects had been implemented were more successful, however, in their efforts to sustain livestock as they had more access to fodder within the village and to credit through SHGs.

Migration was also a common strategy in all villages, but in the case of watershed villages the intensity and duration of migration was much less than it was in other areas. The control villages were almost entirely dependent on funding from the government, borrowing from moneylenders at high rates of interest, mortgaging land or jewellery and migrating. Making charcoal by digging out the roots of *prosopis juli flora* was also practiced by the Thakore community. Table 8 summarises the common drought-coping strategies encountered in the four project areas and how the agencies sought to strengthen these through watershed development and other livelihood based interventions.

As the information in table 8 demonstrates, while watershed activities had substantial benefits in all locations, other livelihood strategies such as migration and the development of non-farm livelihood activities to augment traditional agricultural income sources remained essential. In many cases, the viability of non-farm strategies depended on the existence of community systems and organisations.

*The non-farm livelihood options generated in the NGO case areas can be divided on the basis of their type*

*(whether conventional or new) and on the target beneficiaries (whether individual or group).* The combination of these two variables produces four categories. The agencies in the study used all four categories of livelihood augmentation (Figure 13).

The success of many of these initiatives depended on collective marketing of the produces. In the case of Banaskantha Dwacra Mahila Sewa Association (BDMSA, a federation promoted by SEWA) and the federations of Alwar (promoted by PRADAN), marketing interventions were successfully taken over by these institutions.

For livelihood interventions to succeed in the long run the creation of federated structures which provide marketing support appears to be one of the best of alternatives.

**Conclusions:** Watershed development and rainwater harvesting programmes are not a panacea for drought. The benefits from these programmes depend heavily on the physical and natural resource context, including the

**Building robust institutions is input-intensive both in terms of time and financial resources.**

Figure 13: An Example of Livelihood Augmentation

		Level	
		INDIVIDUAL	GROUP
Options generated	Conventional	Ghee collection Improved agriculture	Salt cooperatives Women's dairy cooperatives
	New (value-added) In the case of BDMSA	Safed musli farming manufacture Gum collection with new technology	Bio-pesticide manufacture Bharatkam Soap from Ratanjyote

**Table 8: Common Drought Coping Strategies with and without Support from Watershed Projects**

Strategy	Conventional Strategies	Impact of Watershed Development
Water security	Deepening of wells (without success) New open and tube wells (mostly failed) Resort to government tankers/pipelines Resort to neighbouring villages	Wells recharged due to water harvesting New wells made due to ground water recharge, wells near percolation tanks Tanker/pipeline supply as a measure of last resort
Shift to animal husbandry	<i>Common features:</i> Distress selling Natural attrition of weak animals Shift to stall-fed animals Retaining 1-2 lactating animals/ household  <i>Special features:</i> Traditional institution of migrating shepherds in Barara to look after animals of other villagers till next monsoon Use of tree leaves in forest areas (Udaipur). Resort to stress fodder from forests during drought.	<i>Strengthening of traditional strategy:</i> Increased fodder supply due to watershed treatment Increased drinking water for animals Credit for purchase of fodder and lactating animals from SHGs and other finance institutions
Scarcity work	Almost entire village dependent on scarcity work from state government and/or <i>panchayat</i>	Reduced dependence on scarcity work - depends on severity of drought and extent of water potential created (e.g., 2 <sup>nd</sup> , 3 <sup>rd</sup> or 4 <sup>th</sup> year)
Migration	Migration of entire families to partial migration for one to six months Working in nearby mines and urban centres on daily basis Masons getting work in urban centres	Migration reduced significantly: Entire family migration almost stopped, Some migration during 3 <sup>rd</sup> , 4 <sup>th</sup> year of consecutive drought
Finance	Loans for marriages and consumption (fodder and good grain) from moneylenders and other local sources including SHGs Mortgaging of land and pledging of jewellery, exorbitant interest rates (e.g. 5%/month) in case of moneylenders	Some increase in debt burden especially among the poor Rescheduling of loans from cooperatives, additional loans in some cases Credit from shopkeepers Loans from SHGs and other institutional sources at reasonable rates of interest
Other alternatives	Charcoal making after digging out roots of <i>Prosopis juliflora</i> Distress selling of land to urban landlords Collection of wild fruits, e.g. gheea at Barara (Santalpur)	Women's milk cooperatives to displace <i>dudhia</i> system in Alwar Diamond polishing in case of Savarkundla *Bharatkam (embroidery) marketed through SEWA Collection of <i>Prosopis</i> gum and marketed collectively through SEWA Soap-making from <i>ratanjyote</i> seeds by SHGs (trial basis in Udaipur)

\*This option existed prior to the watershed intervention.

characteristics of a region's hydrogeology, rainfall, slope and landuse patterns. In addition, the extent and distribution of the benefits received (especially by vulnerable sections of communities such as the landless,

women and small and marginal farmers) depends on access to credit and social inclusion, both of which require robust and equitable institutions. Building robust institutions is input-intensive both in terms of time

and financial resources. This is currently, in broad terms, out of the purview of government supported programmes for NGOs. As mentioned above, guidelines from the Ministry of Rural Development for investment in watershed activities mandate that approximately 80% of the funds made available be invested in physical structures leaving, after NGO overheads, approximately 10% for training and institutional development.<sup>62</sup> In the case of the NGOs reviewed here, however, additional institutional development was financed through the Ford Foundation.

Our review shows that the strength of village-based institutions is positively correlated with both a long-term orientation of the facilitating NGO and high investment in community assets (village commons, tanks, joint forest management areas etc.). Aside from the significant amount of employment generated during the implementation of these programmes, in the post-programme phase indirect benefits are reaped by vulnerable sections of the community. These include increased wage labour opportunities associated with improved agriculture regimes and increased food and fodder security due to shared/contract farming practices. During long droughts of 2-3 or more years, income from non-farm sources of livelihood, such as migration and marketing of commodities produced using locally available resources (for example, gum) and traditional skills (craftwork etc.) of community, becomes critical for most vulnerable populations. While migration is often essential as a source of subsistence income, only in a

few cases did it help in creating physical assets of community. Although we did not study remittance patterns in detail, it is an important area for future study. In addition, remittances and local investments depend heavily on the potentially exploitative forms of non-farm labour employment. Other associated social costs are important too. Both remittance patterns and non-farm employment patters are critical areas for further study in order to understand the capacity of communities to adapt to drought through income diversification.

Aside from migration, the extent of income generated through non-farm activities by vulnerable populations also depend on how successfully NGOs facilitate development of human capital (information, skill and knowledge); institutional capital; and, physical capital (technology). In case of SEWA and PRADAN, strong federations of women's institutions/cooperatives have enabled access to credit (financial capital) and marketing support (institutional capital), which have helped women members of the cooperative to 'live with' droughts.

### Floods: NGO Involvement in Relief and Longer-term Mitigation

NGO involvement in long-term flood mitigation occurs at much lower levels than in the case of drought. Part of this may be a function of location. Some of the most flood-affected regions, such as Bihar and Eastern UP are also least developed in India and, compared to Gujarat and Rajasthan,

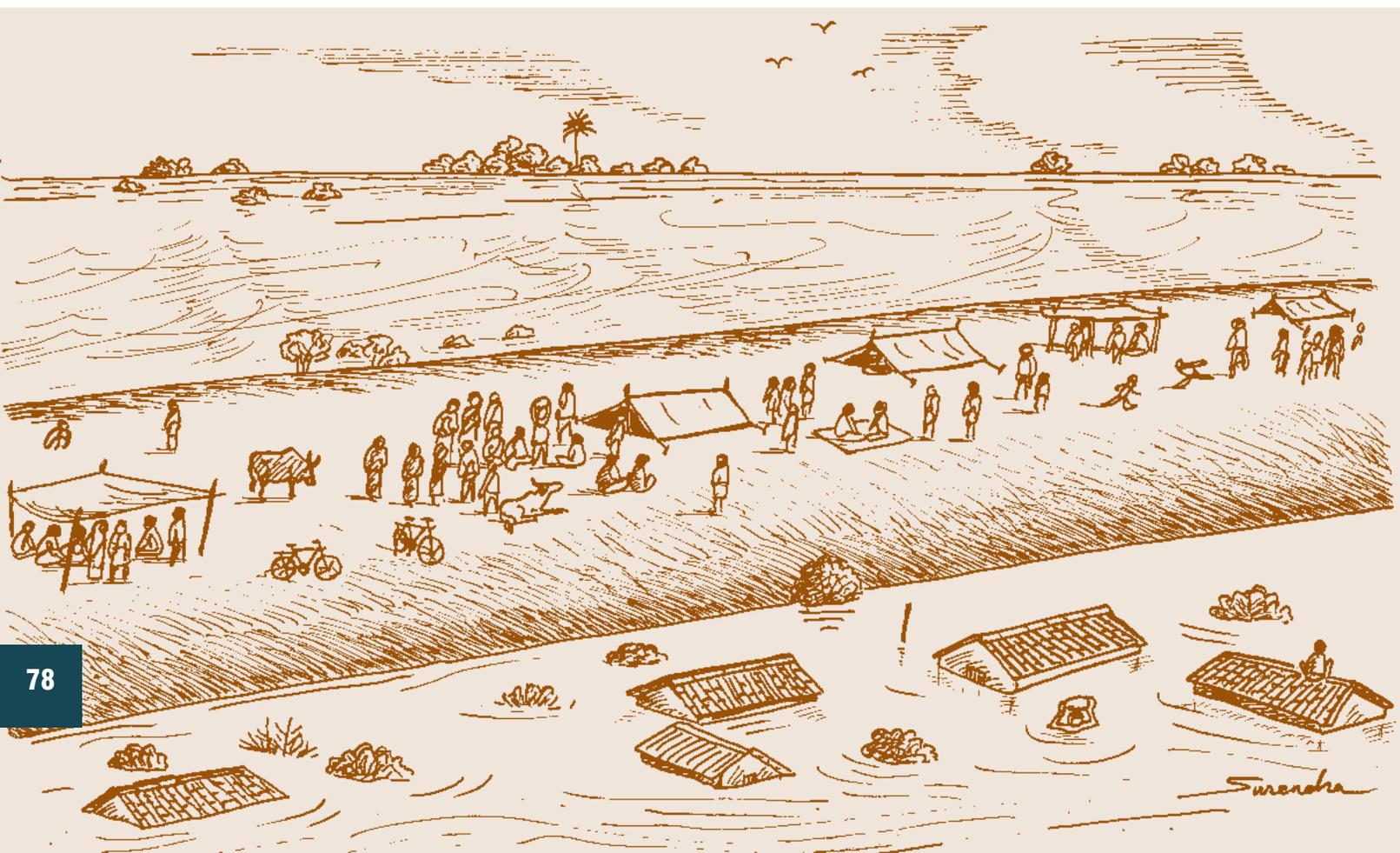
**While watershed activities had substantial benefits in all locations, other livelihood strategies such as migration and the development of non-farm livelihood activities to augment traditional agricultural income sources remained essential.**

lack strong NGO presence and capacity. Poor access to funding sources and lack of programme focus are a major limitation. Watershed development programme activities are concentrated mostly in regions vulnerable to droughts and continue both in normal and drought years. Much of the watershed programme implementation is facilitated by NGOs leading to their sustained presence locally and growth in their capacity. Limitations of NGOs notwithstanding, watershed programmes create a tangible link between long-term development and drought mitigation. In most flood prone regions similar tangible links are absent. As a result, while NGOs are often directly involved in flood disaster response, their involvement in long-term flood

mitigation and development activities has been limited. The case of the Orissa Cyclone illustrates this well.

The Orissa Cyclone in 1999 was, in many ways, a watershed point with respect to NGO involvement in flood and non-drought, climate-related disaster response in India. The cyclone killed nearly 9,000 people and 4,40,000 livestock in a thirty-six hour period starting 29 October.<sup>63</sup> In some locations over 75% of traditional houses were destroyed.<sup>64</sup> In response, approximately 40 local and international NGOs established the Orissa Disaster Mitigation Mission to coordinate their own relief and restoration activities and to coordinate with the government. The activities of these NGOs included the following:

**Watershed development and rainwater harvesting programmes are not a panacea for drought.**



1. Immediate relief, including the provision of cooked food, shelter and medical services,
2. Interim food security and revival of institutions such as schools and social organisations in the immediate post-relief period; and, to a certain extent,
3. Long-term activities to restore livelihoods and reduce vulnerability.

NGO involvement in immediate disaster relief was extremely high. Government and international donor funds poured into Orissa and NGOs were at the forefront in the actual delivery of relief supplies and services. In many cases, this included such vital and difficult to achieve activities as the delivery of cooked food into regions where, despite food availability, local populations lacked the capacity to cook it and were, as a result, on the verge of starvation.

In the period immediately following the cyclone, government and donor funds for rehabilitation activities continued to pour into Orissa. During this period, many NGOs initiated interim and long-term mitigation activities that involved attempts to restore and initiate non-farm livelihoods, promote the formation of micro-credit organisations and encourage the formation of self-help groups. In addition, resources were used to construct multi-purpose cyclone shelters and strengthen community disaster preparedness systems through training and planning activities. Sustaining these efforts has unfortunately not always proved

possible. As Aurobindo Behera, the Managing Director of Orissa's 'State Disaster Management Authority' commented in 2002: 'NGOs that could mobilise resources went ahead with long-term development initiatives even as others withdrew from the scene'.<sup>65</sup> Reviews of international assistance in the wake of the Orissa cyclone emphasised the links among relief, rehabilitation and long-term development.<sup>66</sup> These and the emerging global consensus regarding the importance of recovery activities that reduce vulnerability probably contributed to initiatives, such as that undertaken by UNDP following the 2001 floods in Orissa, that sought to reduce vulnerability by revising rice planting dates.<sup>67</sup>

The above said, in the case of the Orissa cyclone the rehabilitation activities supported by international NGOs were often less effective than immediate relief activities and were often subject to donor-defined time constraints.<sup>68</sup> As a result, the strength of NGO activities gradually dissipated. Groups that were able to raise funds gradually shifted their primary focus back to long-term development, while others pulled out. In 1999-2000, immediately following the cyclone, central government allocations from the National Fund for Calamity Relief to Orissa totalled IRs 8,281.5 million<sup>69</sup> far more than the IRs 350 million provided by the same source to mitigate drought in 2000-2001. Flood and cyclone relief often involves huge surges of water and funds followed by a relative scarcity of both.

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**NGO involvement in long-term flood mitigation occurs at much lower levels than in the case of drought.**

The situation in Orissa has many parallels with the conditions in the Nepal Tarai, Bihar and eastern Uttar Pradesh, where the case studies for this project were carried out. NGOs, which work on flood-related issues, are rare and they have relatively limited capacities. They are often dependent on just a few international donors, such as OXFAM. When donor priorities shift or donors reduce their focus on a given

area, there are few alternative sources of finance and the NGO activities decline. Only a few high profile NGOs, such as the Gorakhpur Environmental Action Group, are able to develop the capacity to tap into diverse sources of international and other financing and, with this, slowly build their own capacity to deliver support that links flood mitigation with overall development.

## LINKS TO EMERGING DEBATES OVER DEVELOPMENT AND DISASTER MITIGATION

Emerging global perspectives on disaster response and mitigation emphasise the central role played by livelihood systems and entrenched institutional relations in the creation and re-creation of vulnerability.

The above analysis of the changing social and hydrological context and the institutional environment surrounding flood and drought mitigation highlights three core issues:

1. The social, the economic and indeed the hydrological context in which floods and droughts occur is undergoing processes of transformative change where urban-rural inter-linkages heavily influence the vulnerability of livelihoods;
2. The institutional history and context of development and disaster mitigation has produced a relatively narrow range of governmental responses that focus on structural measures for water control and disaster relief as the primary mechanisms for responding to floods and droughts and ignore on the role of social institutions; and
3. The involvement of civil society and NGOs in flood and drought relief and mitigation recognises the importance of community institutions and local livelihood systems as central to both long-term development and disaster mitigation but such organisations have had a hard time translating that recognition into programmes with the sustained financial basis required for widespread implementation. Particularly in flood-prone areas, where major, sustained sources of finance for mitigation, like that for watershed programmes in drought-prone areas do not exist, the continuity of support to communities is poor. Furthermore, even in areas where watershed activities are implemented most interventions are structural (investments in the physical treatment of watersheds) and only poorly recognise urban-rural livelihood links.

Emerging global perspectives on disaster response and mitigation emphasise the central role played by livelihood systems and entrenched institutional relations in the creation and re-creation of vulnerability. In their classic analysis of disaster vulnerability, *At Risk*, Wisner, Blaikie, Cannon and Davis emphasise the central role of governance in risk reduction and the need to build risk reduction into sustainable development.<sup>70</sup> They also emphasise the need to reduce risks by improving livelihood opportunities and list a series of measures that are central to this. They include the following:

- *Diversifying income sources* for the vulnerable within and outside the agricultural sector, with a view to capital formation and the building up of assets of their own.
- *Diversifying agricultural production* and the crops grown.
- *Increasing food security* by enhancing local subsistence production (returns to labour and land, and reduction of risk through climatic variation).
- *Facilitating local networks* of support and risk awareness.
- *Strengthening local coping mechanisms* through the decentralisation of decision making.
- *Developing ‘buffers’* (including food, cash savings and accessible forms of insurance) to cushion the trauma of disasters.
- *Developing crops and seeds storage* (e.g. community grain banks).
- *Securing increased, equitable access to key resources* for those ‘at risk’ (including natural and financial resources – see below – as well as logistical and informational resources such as timely information about extreme events, transportation where evacuation is required,

**Effective governance is central to risk reduction.**



For building roads and bridges in the lower Ganga Plains, stone are imported from the hills.

**The context of rural life in India and Nepal is dynamic and is undergoing fundamental changes, but approaches to flood and drought mitigation are relatively static.**

- shelter, emergency health services, communication with relatives, etc.)
- *Challenging the structures of domination* that impede the equitable distribution of livelihood resources (including urban and rural land reform, dissemination of knowledge about land law, and vigorous public oversight and regulation of privatised services such as water and electricity).
- *Developing micro-credit* and small-scale, decentralised banking systems.
- *Public provision of universal education and health care in the longer-term* and subsidies allowing universal coverage within privatised or mixed delivery systems in the short-term.
- *Recognising the importance of the local state, the municipality and mediating institutions (NGOs) as facilitators* of access to key resources for livelihood sustainability.
- *Giving the necessary encouragement, funding and facilities for women's empowerment*, through actions such as adult literacy classes, training in interpersonal skills, accounting, managing public meetings, etc., savings clubs, women-only micro-credit and training to combat the threats present after disasters (for example, polluted drinking water, epidemic disease in children).<sup>71</sup>

Many of the above measures for improving livelihoods parallel the wider processes of economic evolution

within society. As rural-urban inter-linkages and the peri-urbanisation of rural areas increases, opportunities for income diversification also increase, as do opportunities for information flow, communication and access to institutions and social networks that extend beyond the bounds of flood or drought-affected areas.

Unfortunately, these wider perspectives are poorly integrated into the flood and drought mitigation activities currently being undertaken by governments and often also by NGOs, in India and Nepal. Investment by governments tends to focus heavily on structural measures for water control. While programmes such as the watershed programme in India are beginning to develop a link between drought mitigation and long-term development, most of the budget is tied to the construction of watershed treatment structures and may have relatively little relationship to livelihoods or to the wider processes of change. Furthermore, in flood-prone areas long-term activities similar to the watershed programme in drought-prone areas do not exist. Thus, there is no substantive link between development processes at the community level and reductions in vulnerability to flooding.

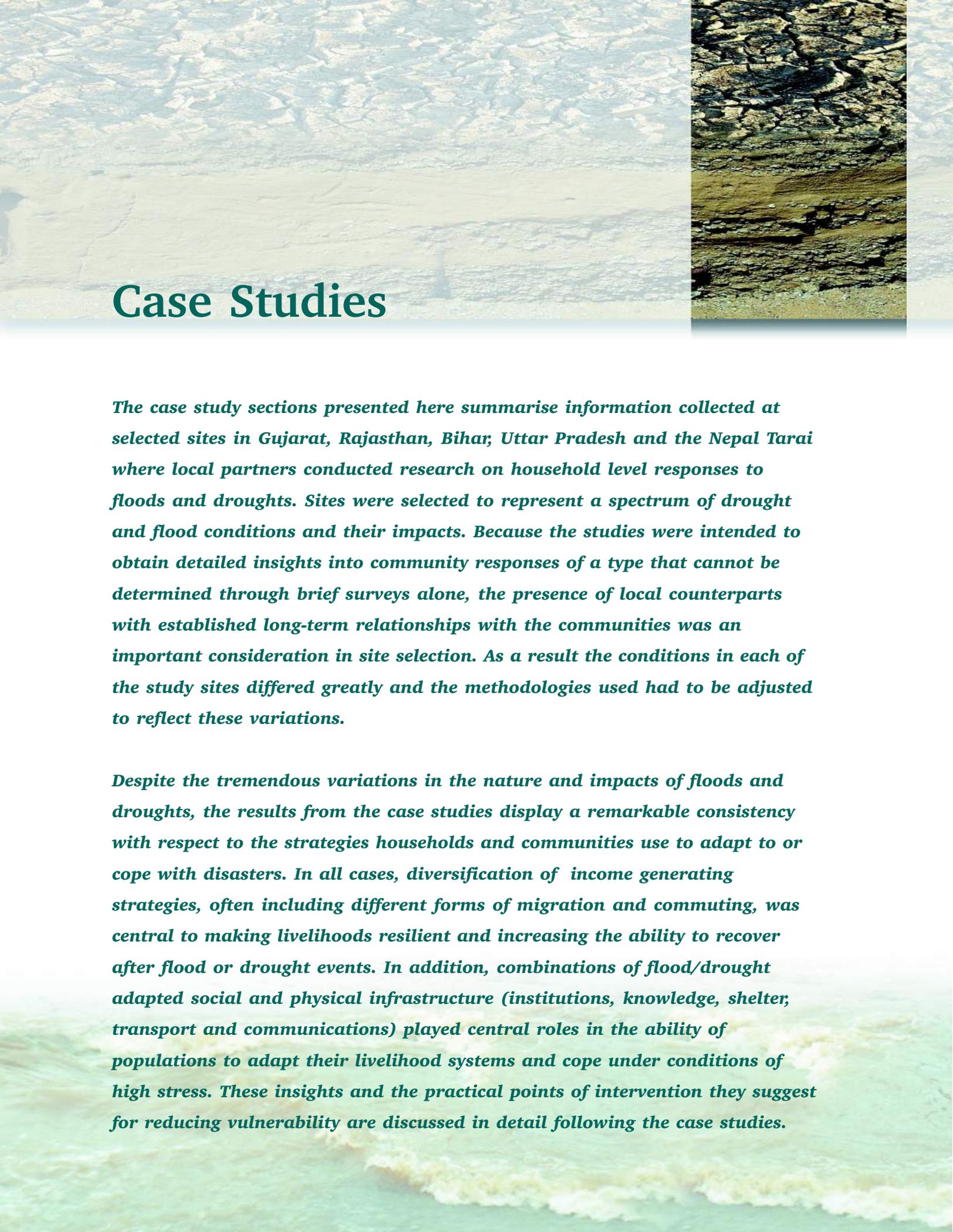
Overall, although context of rural life in India and Nepal is highly dynamic and is undergoing fundamental changes, approaches to flood and drought mitigation are relatively static. They focus on building physical structures for water

control and place little emphasis on the role livelihood systems play in the creation and reproduction of vulnerability at the household level. The case studies in the next section

of this report examine dynamics at the household level and what people in a series different regions are actually doing to respond to floods, droughts and climatic variability.

## Endnote

- <sup>1</sup> Much of the information on which this section is based was collected in collaboration with the British Geological Survey COMMAN project.
- <sup>2</sup> Censuses of India, 2001, 1991, 1981
- <sup>3</sup> <http://www.censusindia.net/>
- <sup>4</sup> Classes VI, V and IV towns with less than 20,000 inhabitants
- <sup>5</sup> Dev (2002)
- <sup>6</sup> *Ibid.*
- <sup>7</sup> Srivastava (1998) and Dev (2002)
- <sup>8</sup> Dev (2002)
- <sup>9</sup> Adger, Kelly *et al.* (2002)
- <sup>10</sup> Shakya (2002)
- <sup>11</sup> Start (2001)
- <sup>12</sup> Sundaram (2001) and Dev (2002)
- <sup>13</sup> Sundaram (2001)
- <sup>14</sup> Wage rates for 1999-2000 normalised to 1993-94 prices.
- <sup>15</sup> Start (2001)
- <sup>16</sup> Deb, *et al.* (2002)
- <sup>17</sup> Personal communication, Himanshu Kulkarni, ACWADAM, Pune
- <sup>18</sup> Moench (1988)
- <sup>19</sup> Gyawali, Schwank *et al.* (1993)
- <sup>20</sup> McGee (1991)
- <sup>21</sup> Gyawali, Schwank *et al.* (1993)
- <sup>22</sup> Centre for Science and Environment (1982; and 1985)
- <sup>23</sup> Thomas (1971)
- <sup>24</sup> World Bank and Ministry of Water Resources, Government of India (1998)
- <sup>25</sup> Burke and Moench (2000)
- <sup>26</sup> Bandara (1977)
- <sup>27</sup> Kahnert and Levine (1989) and Ilich (1996)
- <sup>28</sup> Personal communication, CGWB officials attending the IWMI strategic review meeting, October 3, 2003, New Delhi.
- <sup>29</sup> Rogers, Lydon *et al.* (1989); Centre for Science and Environment (1991); Mishra (1997); Dixit (2002), Gyawali (2003) and Chaturvedi and Saroch (2004)
- <sup>30</sup> Dhawan (1988); Shah (1993); World Bank and Ministry of Water Resources - Government of India (1998); Moench (2003); Shah, Roy *et al.* (2003)
- <sup>31</sup> Kaczmarek, Kundzewicz *et al.* (1996)
- <sup>32</sup> Gyawali (2003)
- <sup>33</sup> Pradhan (1989)
- <sup>34</sup> Gyawali (2001)
- <sup>35</sup> Gyawali and Schwank (1994); Gyawali and Dixit (2000)
- <sup>36</sup> Thompson *et al.* (1986); Ives and Messerli (1989)
- <sup>37</sup> See Rana (1996)
- <sup>38</sup> WECS, Water Plan June (2003)
- <sup>39</sup> This section by M.S. Rathore and Srinivas Mudrakartha
- <sup>40</sup> Narain, Sharma *et al.* (2000)
- <sup>41</sup> Rao (1994)
- <sup>42</sup> IJAE (1994)
- <sup>43</sup> Rao (1994)
- <sup>44</sup> In comparison with other anti-Poverty programmes, PDS turns out to be the costliest. As the fact is that if only the Central Government costs are considered, an amount of Rs 4.27 was incurred to transfer one rupee of income to poor.
- <sup>45</sup> For detail survey see S. M. Jharawal (1998) 'Public Distribution System in India', Manak Publication Pvt. Ltd. New Delhi.
- <sup>46</sup> Government of India, Ministry of Water Resources (2000)
- <sup>47</sup> As cited in D'Souza (a) (1999)
- <sup>48</sup> D,Souza (1999)
- <sup>49</sup> Agarwal and Chak (1991)
- <sup>50</sup> Roy (2000)
- <sup>51</sup> *Ibid.*
- <sup>52</sup> Krishankumar (1999)
- <sup>53</sup> The Times of India (1999)
- <sup>54</sup> RBA (1980)
- <sup>55</sup> Tiwari (1999)
- <sup>56</sup> Sinha, Flooding in Bihar (2002)
- <sup>57</sup> Lok Sabha, Unstarred Question No. 4301, 12.08 2002
- <sup>58</sup> Smt. Bijoya Chakarborty, Minister of State in the Ministry of Water Resources replying to a question asked by MP Laloo Prasad Yadav, Rajya Sabha, Unstarred Question No 3377, 22.04.2003
- <sup>59</sup> Ministry of Water Resources (2000)
- <sup>60</sup> The welcome emphasis on the need to incorporate disaster mitigation into development activities in the Tenth Five-Year Plan document marks a distinct change from this history. This emphasises information and non-structural forms of mitigation (such as the development of insurance systems) and, if implemented, could initiate a major progressive departure from India's hardware focused history of disaster mitigation. (Government of India, Tenth Five-Year Plan : 2002-07, Chapter 7)
- <sup>61</sup> Chopde, Pastakia *et al.* (2003)
- <sup>62</sup> Ministry of Rural Development (2001)
- <sup>63</sup> Behera (2002)
- <sup>64</sup> (IMM Ltd. 2001) Citing a CRS report entitled: 'Baseline Livelihood Survey of CRS/DFID Livelihood Restoration Project' CRS Bhubaneswar.
- <sup>65</sup> Behera (2002)
- <sup>66</sup> IMM Ltd. (2001)
- <sup>67</sup> UNDP (2001)
- <sup>68</sup> International NGO Training and Research Centre INTRAC (2000)
- <sup>69</sup> Lok Sabha Unstarred Question No. 3324, dated 06.08.2002 - [www.IndiaStat.com](http://www.IndiaStat.com)
- <sup>70</sup> Wisner, Blaikie *et al.* (2004)
- <sup>71</sup> *Ibid.*



# Case Studies

*The case study sections presented here summarise information collected at selected sites in Gujarat, Rajasthan, Bihar, Uttar Pradesh and the Nepal Tarai where local partners conducted research on household level responses to floods and droughts. Sites were selected to represent a spectrum of drought and flood conditions and their impacts. Because the studies were intended to obtain detailed insights into community responses of a type that cannot be determined through brief surveys alone, the presence of local counterparts with established long-term relationships with the communities was an important consideration in site selection. As a result the conditions in each of the study sites differed greatly and the methodologies used had to be adjusted to reflect these variations.*

*Despite the tremendous variations in the nature and impacts of floods and droughts, the results from the case studies display a remarkable consistency with respect to the strategies households and communities use to adapt to or cope with disasters. In all cases, diversification of income generating strategies, often including different forms of migration and commuting, was central to making livelihoods resilient and increasing the ability to recover after flood or drought events. In addition, combinations of flood/drought adapted social and physical infrastructure (institutions, knowledge, shelter, transport and communications) played central roles in the ability of populations to adapt their livelihood systems and cope under conditions of high stress. These insights and the practical points of intervention they suggest for reducing vulnerability are discussed in detail following the case studies.*

## DROUGHTS

Studies of drought in Gujarat were conducted by Vikram Sarabhai Center for Development Interaction (VIKSAT), an NGO with a long history of involvement in supporting communities in water management, and in Rajasthan by the Institute of Development Studies, an academic research organisation. The Gujarat study focuses in depth on a limited number of sites where VIKSAT has long-term connections with local communities. In order to explore the wider applicability of patterns observed in location specific studies such as those in Gujarat, the Rajasthan study involved a much wider survey of conditions across major regions.

### Gujarat

Almost three-quarters of Gujarat is arid or semi-arid and suffers from recurrent water scarcity. This climate is a major factor contributing to regular drought, desertification and, in some areas, salinisation. Kutch,

Gujarat’s largest district, frequently experiences extended droughts. Of the past fifty years, thirty-three were classified as drought years. Gujarati folklore captures this in one popular tune, *‘Tujhya gharaat naahi paani, ghaaghar utaani re’* (‘There is no water in your house, go and fetch water in your pot’) a commentary on the shortage of water.

### Description of the Area

The study areas selected by VIKSAT are as follows:

- Five villages in Satlasana Taluka, Mahesana District;
- Five villages in Bhiloda Taluka, Sabarkantha District; and
- Ten villages in Bhuj Taluka, Kutch District.

Mahesana and Sabarkantha districts fall in North Gujarat, which forms the uppermost part of the Sabarmati River basin. Both North Gujarat and Kutch are drought-prone areas. The discussion below outlines in brief the physical, social and climatic features of the three field study areas.

**Bhiloda**, located in a semi-arid zone with an annual rainfall of 700 mm, is dominated by the Dungari Garasia tribe. Livelihoods here are based on collecting and selling forest products and agriculture. In addition, at least one member per family works in the government sector, thanks to reservation for tribal people. Only about three per cent of people in Bhiloda are landless – a factor that can

Almost three-quarters of Gujarat is arid or semi-arid and suffers from recurrent water scarcity.



be attributed to three core factors: (i) government distribution of land to tribal communities; (ii) loans provided to tribal people for the purchase of land under government-sponsored schemes; and (iii) special subsidies available under certain government programmes for agriculture that have encouraged tribal people to buy land. Marginal farmers constitute the majority about 71% of Bhiloda's total population. The average literacy rate is 57% for males and 43% for females. Literacy rates for Gujarat state as a whole average 61.29%, with 62% of males and 38% of females literate.

**Satlasana** is located in a drought-prone area with an annual rainfall of 700 mm. The community is heterogeneous and is dominated by Darbars, followed by Harijans (who include Parmar, Maheshwari, Solanki, Vankar and Waghri) and Muslims. Livelihoods are based on agriculture and animal husbandry. Fourteen per cent of the people of Satlasana are landless, of which 57% are Harijans. Most inhabitants of Satlasana are marginal (63%) and small farmers. Only one farmer in the survey possessed more than five acres of land. The average literacy rate in Satlasana is 61.2%, with 69% of males and 31% of females literate.

**Bhuj** receives about 350 mm of rain a year and is located in an arid, severely drought-prone area. The community is dominated by Rabari, followed by Bharvad and Darbar communities. Livelihoods are based on animal husbandry, handicraft production and

agriculture. About 57% people in Bhuj are landless. However, most have settled on government land and cultivate rain-fed *kharif* crop during the monsoon.

Bhuj experiences repeated occurrences of natural calamities such as earthquakes, cyclones and droughts. The year 2001 saw the second most severe earthquake in India's recorded history, measuring 7.6 on the Richter scale, and was also a drought year. The average literacy rate here is 50%, with 56.42% for males and 43.58% for females.

The following sections describe the social context of the region.

The women of all three locations follow *purdah*, or the wearing of veils. In Bhiloda and among the women from the Darbar community in Satlasana, interaction with elder males and speaking in front of elders is discouraged and women are not allowed to go out for work.

Houses are classified as *kachha* (semi-permanent) and *pakka* (permanent). *Kachha* houses need repair every year and some components, such as roofs need replacement. There are more *kachha* houses (83%) than *pakka* (17%) in Bhiloda. Materials, such as bamboo, grass, small timber and stones, are obtained from the forests under joint forest management programmes.

Historically and culturally, tribal people are used to living in *kachha* houses. In Bhuj, however, there are more *pakka* (71%) than *kachha* houses (29%). This is due to the large number of shelter reconstruction programs established after the earthquake of January 2001. A

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**Declines in water availability and irrigated area have had a ripple effect throughout the agricultural economic system.**

*pakka* house does not, therefore, necessarily reflect the economic status of the household in question. In Satlasana, the number of *kachha* (49%) and *pakka* (51%) houses are roughly equal.

### Drought-related Trends During 1999-2003

Food consumption declined during drought periods in two out of three locations studied. Overall food expenditure decreased by 70% in Satlasana and vegetable consumption dropped 73%; in Bhiloda the decrease averaged 26%. In contrast, food expenditures in Bhuj saw a 9% increase in 2001, probably due to the increase in cash flow from post-earthquake relief programs. Spending on rituals and festivals did not change much in Bhiloda or Bhuj, but dropped by 90% in Satlasana.

Maize is the major food grain consumed during periods of droughts in Bhiloda. In Satlasana, *bajra*

(millet) was the main food grain eaten during droughts until it was replaced by wheat. One reason for this change is the distribution of wheat as partial payment for drought relief work.

### Methods

A multi-stage, stratified, random sampling method was adopted to collect data. Primary data were collected through a pre-tested structured questionnaire developed for use in all case study areas. The questionnaire was utilised to collect information on 400 households (100 each in Satlasana and Bhiloda and 200 in Bhuj). To supplement this, participatory methods were applied to collect information and insights on thematic aspects of livelihood occupations and gender relations. In addition, secondary data on village, *taluka* and district statistics were collected. Finally, in order to explore village-level patterns of livelihood adaptation to drought, many life stories were documented.

Food consumption declined during drought periods in two out of three case locations.



Maize harvest before storage.

Fieldwork for this case study was conducted in April and May, 2003, toward the end of an extended, multi-year, period of sustained and often intense drought (See figures 14 and 15).

### The Impacts of Drought

In all case study areas, the impacts of drought varied. They included declines in groundwater levels, drinking and irrigation water scarcity, reduced agricultural productivity and production, fodder scarcity and reduced food security were evident. Specific impacts are discussed in detail below.

**Drinking water scarcity:** In all three areas almost all the wells went dry due to the continued drought. Only a few farm wells in each of the villages were capable of supplying a limited amount of water each day. As a result, there was a severe drinking water shortage in all three case study areas. In Satlasana this changed in 2001-2002 when a rural drinking water supply scheme bringing water from the Narmada river (Sardar Sarovar Project) was implemented. This largely alleviated the drinking water problems in the area. Recently, however, supplies have declined and instead of being available on a daily basis piped water is available only twice or thrice a week. In Bhuj and Bhiloda, people had to walk long distances to fetch water from wells located on private farms. The government intermittently provided water supplies using hired tankers.

**Decline in area under irrigation:** Due to rapid declines in groundwater levels and the resulting water scarcity in irrigation wells, drought impacts were

Figure 14: Rainfall in Satlasana Gujarat



Figure 15: Rainfall Pattern in Bhiloda and Bhuj, Gujarat



felt almost immediately in Satlasana. In contrast, in Bhiloda water levels declined gradually over a year or more. Many local people attributed the slow decline to the presence of extensive forest areas that have been protected under joint forest management programs in almost 57 adjacent villages.

An analysis of the primary data highlights the vulnerability of Satlasana. As can be seen from figures 16 and 17 drought had a major impact on cropped areas. In both villages, *rabi* (winter) season cropping (which requires irrigation) declined to minimal levels and agriculture was eliminated during the hot season.

**Almost all the wells went dry due to the continued drought.**

**In Satlasana, groundwater declines are widely recognised but this is attributed to natural or religious reasons rather than to increased use.**

It is important to recognise that figures 16 and 17 understate drought impacts. While major declines in precipitation first occurred in 1999 and continued in subsequent years, agricultural areas were already declining during the *rabi* season before precipitation levels declined. The decline in *rabi* cropping was primarily due to gradual declines in groundwater availability and, as a result, reductions in the ability of farmers to irrigate during the non-monsoon season. Although most farmers planted the entire agricultural area during the *kharif* season throughout the drought period, yields declined rapidly. In comparison with

the yields of 1998, the last year before the drought started in 1999, yields during the *kharif* season declined by half in 1999 for all crops. From 2000, the second year of drought, onwards crop production was minimal due to the lack of irrigation water and many farmers were forced to abandon fields after sowing. The decline in production is illustrated in table 9 in the case of Bhanavas village.

Aside from agricultural production *per se* it is important to note that the *rabi* crop is also important source of fodder for livestock. Agriculture residues from cropping during the *rabi* season are stored for the summer. Crop failure thus has an adverse impact on livestock and associated income streams.

Figure 16: Changes in Cropped Area, Nana Kothasana, Satlasana, Gujarat

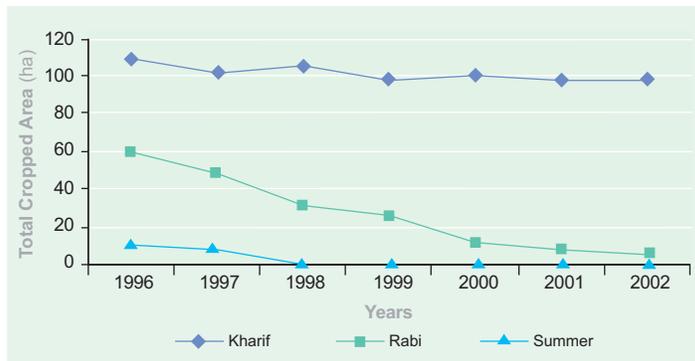
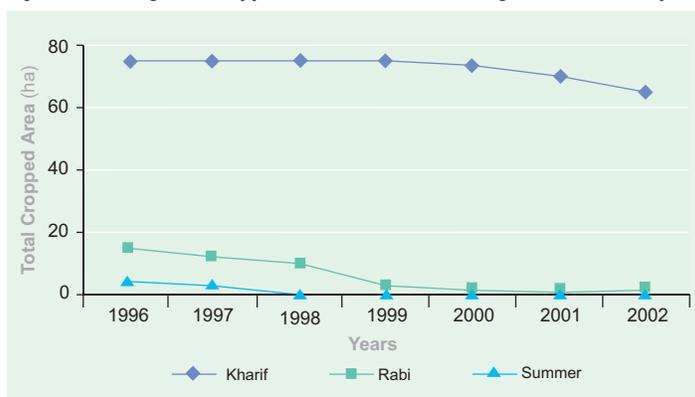


Figure 17: Changes in Cropped area in Bhanavas Village, Satlasana, Gujarat



**Groundwater depletion:** Drought across Gujarat enhanced an already rapid decline in groundwater levels. In the case study regions, the most common responses at the village level have involved the deepening of wells, the extension of vertical and horizontal bores and/or the drilling of new borewells, all in an effort to chase the ever-declining water table. Declines in groundwater levels in all three study areas are significant and, because most areas are underlain by hard impermeable rock, well yields tend to decline with depth. As a result, efforts to deepening existing wells are generally ineffective and rarely result in owners being able to maintain constant levels of irrigation. This is demonstrated in figures 18 and 19, which document the relationship between well deepening and the area irrigated by each well.



Depleted groundwater well.

The following conclusions can be drawn from the data presented and a wider review of hydrogeological conditions conducted as part of a separate project<sup>1</sup> undertaken in collaboration with the British Geological Survey:

- a. Initial efforts to deepen wells during the late 1980s and early

1990s helped farmers to tap additional quantities of water from the top aquifer (the upper 30-40 metres) in most wells. Subsequent deepening that took place during the drought (1999-2002) failed to increase water availability as most of the wells struck hard rock. In some cases farmers attempted to deepen wells

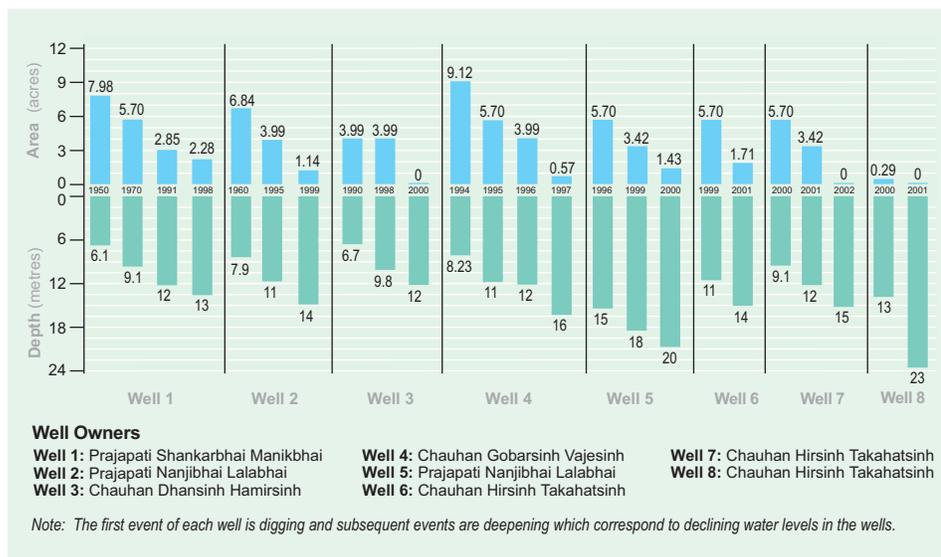
Virtually all loans for well deepening were taken at high rates of interest from informal sources such as moneylenders.

Table 9: Decline in Production of Selected Crops (%), Bhanavas

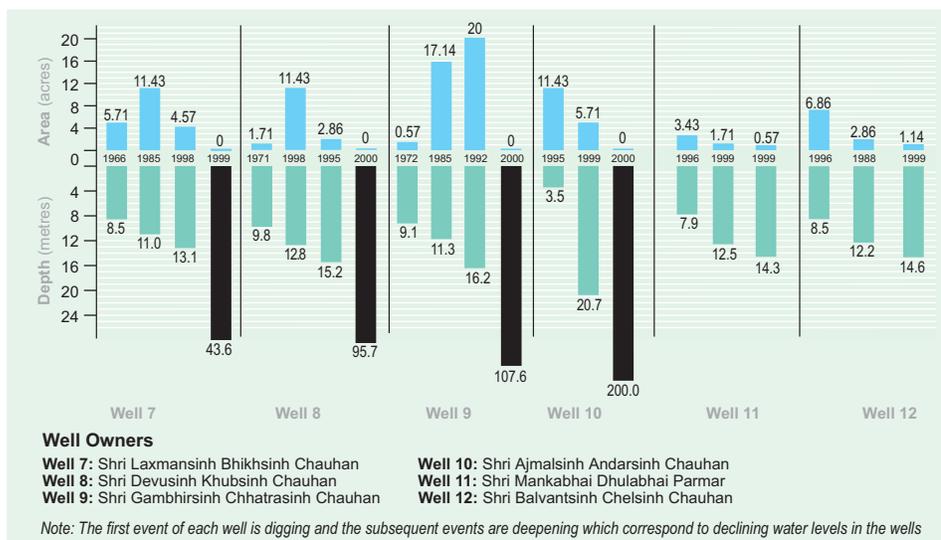
Years\Crops	1998 (Base)	1999	2000	2001	2002
<b>Monsoon crops (Kharif)</b>					
Groundnut	100	50	No cultivation	No cultivation	Crop failed
Cluster beans	100	30	No cultivation	No cultivation	Crop failed
Maize	100	50	No cultivation	No cultivation	Crop failed
Minor millet (Bajra)	100	70	50	25	Crop failed
<b>Winter crops (Rabi)</b>					
Wheat	100	50	25	10	5
Mustard	100	50	No cultivation	No cultivation	No cultivation
Tobacco	100	10	No cultivation	No cultivation	No cultivation

Note: Summer crops were confined to small patches of fodder cultivation during this period. 1998 was a normal year and considered base year  
Source: Mudrakartha et al. (2003).

Figure 18: Well Deepening vs. Area Irrigated by Sample Wells, Nana Kothasana



Well deepening was concentrated between 1999 and 2003 but the area of irrigation during this period continued to decline.



- a. by blasting into hard rock but this failed.
- b. A few wells and surface borewells, particularly those which encounter highly fractured pegmatite veins, continue to yield moderate to substantial quantities of water.
- c. The area under irrigation through wells and borewells has declined rapidly since 1996 and reached a historic low in 2002. This was caused by the dewatering of top, high-yielding aquifers.
- d. Well deepening was concentrated between 1999 and 2002 but the area of irrigation during this period continued to decline. The inverse relationship indicates that the attempt farmers made to maintain water supplies had little success.

Figure 19: Well Deepening, Bhanavas

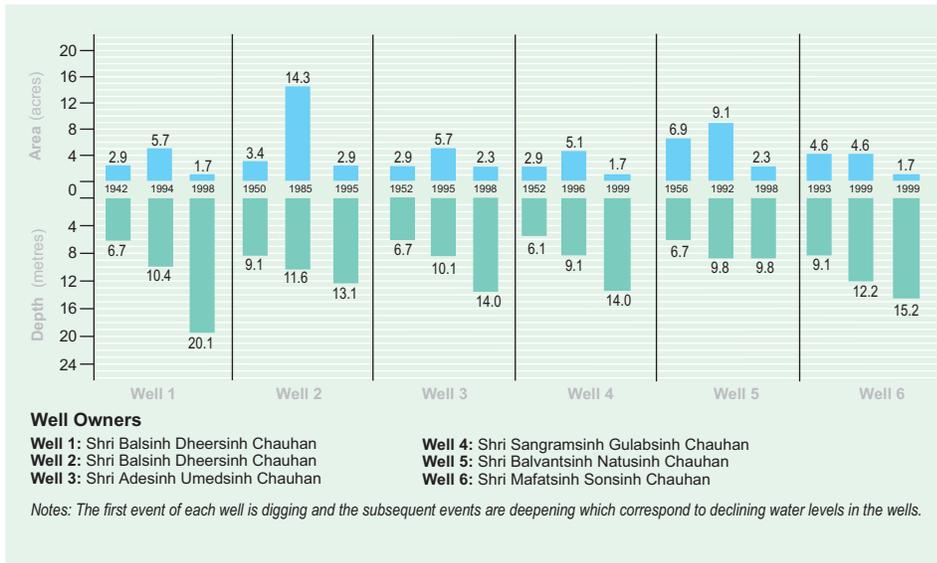
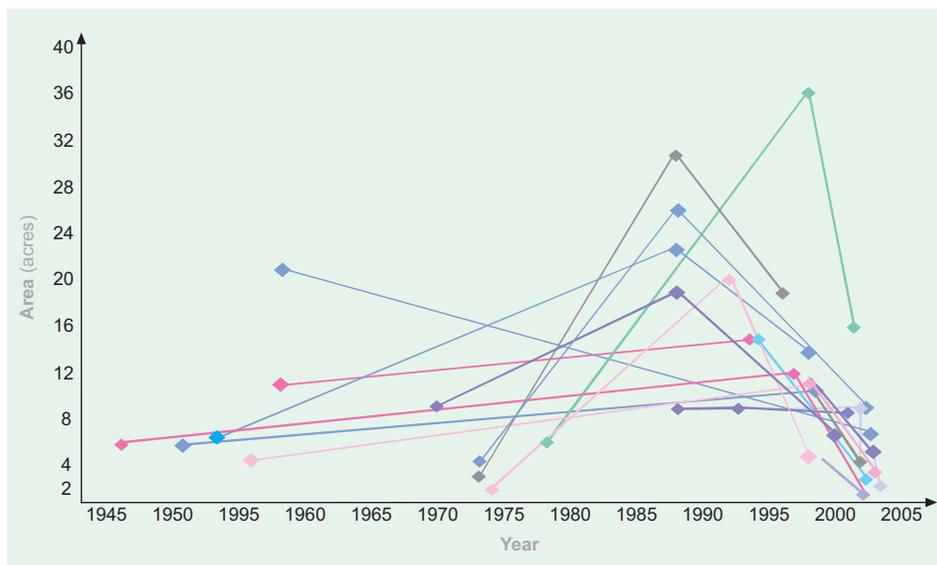


Figure 20: Area Irrigated by Wells after Deepening



Groundwater depletion impacts are the culmination of a long-term process accentuated by the recent drought.

Groundwater depletion has a major impact on agriculture and related activities. These impacts are the culmination of a long-term process accentuated by the recent drought. The history of the eight wells in Nana Kotasna village is illustrative as shown in figure 20. Most farmers have small

or marginal landholdings. As a result, when these wells were initially constructed, the amount of water that could be pumped often exceeded the amount farmers required for use on their own lands. During the late 1980s and early 1990s farmers sold surplus supplies to neighboring landowners

and active water markets developed. At that time, the terms of water sale involved either crop sharing arrangements in which one-third of the crop was exchanged for irrigation water or hourly rates between Rs10 and 25 were fixed depending upon the crop and the season. As well yields declined and water scarcity increased, the area of land irrigated declined and most water marketing arrangements went out of existence.

**Crop failure also has an adverse impact on livestock and associated income streams.**

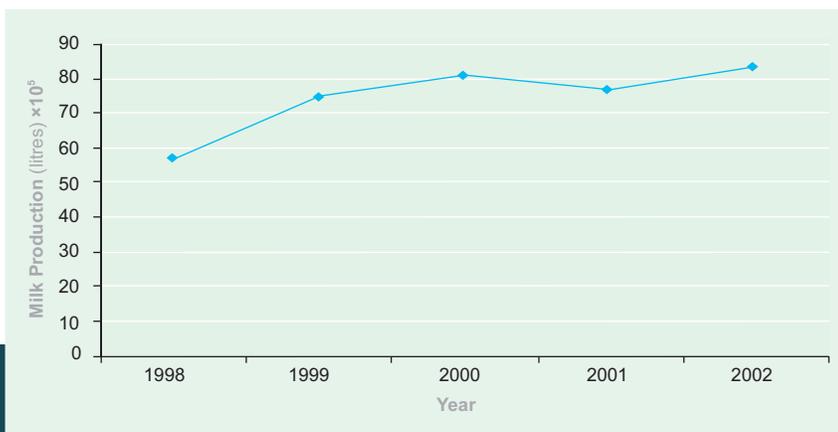
**Impacts on income across the agricultural economic system:** Declines in water availability and irrigated area have had a ripple effect throughout the agricultural economic system. Because official sources of credit are unavailable for groundwater development in this area, much of the deepening was financed by selling or pawning assets such as jewelry and by using high-interest (3-5% per month) loans from local moneylenders, who also serve as sellers of agriculture inputs. It became impossible to recover this capital as, in all areas, income from agriculture has declined. In Satlasana, many farmers attempted to

maintain income levels by shifting resources out of irrigated agriculture and into animal husbandry and milk production. Feed concentrate provided by the regional dairy cooperative became a critical input. Because sufficient fodder, which requires irrigation, could not be produced locally, this concentrate was mixed with fodder purchased from distant markets at high prices. As a result, as figure 21 indicates, milk production actually increased in villages like Umri, Satlasana.

Similar shifts did not, however, occur in Bhiloda and Bhuj, the other study areas. In all three study areas, however, the incidence of cattle mortality was high and in many cases people sold some livestock at cheap rates in order to sustain their productive cattle.

In Bhiloda, despite the drought, 31% of the population persisted with agriculture as their main source of income, while in Satlasana and Bhuj agriculture declined to just four per cent of the total income sources. People in Bhiloda believed that the adjacent protected forestlands would help absorb the effects of drought to a certain extent and as a result the effect would be delayed. In Satlasana, the effect of drought was felt almost immediately. As the ability of farmers to earn income from agriculture on their own lands declined, approximately 36% took up work as agricultural labours and 21% of working-age men migrated. Out of this, a significant fraction (nine per cent of the workforce) left for more

Figure 21: Milk Production in Umari During Drought in Satlasana



Source: Dairy Co-operative Society, Umari, 2003.

than six months to engage in sharecropping, diamond polishing and construction. In addition, a very significant portion of the working population (Bhiloda 69%; Bhuj 51%; Satlasana 65%) in all case study areas shifted into non-agricultural labour because of the drought.

In terms of the primary occupation, there was a clear shift from agriculture (which was 70% before drought, and declined to 4%) to animal husbandry (which was 6% before drought and increased to 16%) and toward non-farm sources of income. In addition, except in Satlasana, where there are cultural barriers to women working outside of the home, there was an increase in the role of women in the workforce. Much of this was for wage labour but in Bhuj where other sources of income are open to women, 21% were primarily engaged in handicrafts.

Overall, despite major shifts out of agriculture, for most families it was not possible to offset declines in agricultural income through an increased emphasis on animal husbandry and non-farm income sources. This is clearly indicated by the case study of Shri Vjiesinh Andarsinh from Bhanavas village shown in the accompanying box 3.

Changes in income during the drought for each of the case study areas are documented in the figures 22, 23 and 24.

As the figures document, in all case study areas, there was a general decrease in the income levels of all income classes during the drought. The

Figure 22: Change in Income Distribution Drought and Normal Years, Bhiloda

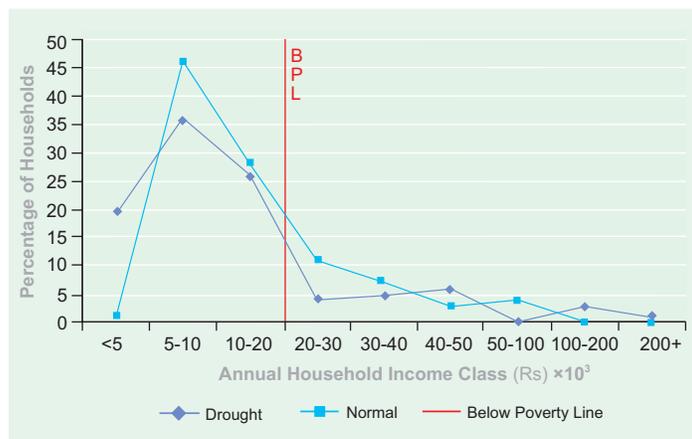


Figure 23: Change in Income Distribution Drought and Normal Years, Satlasana

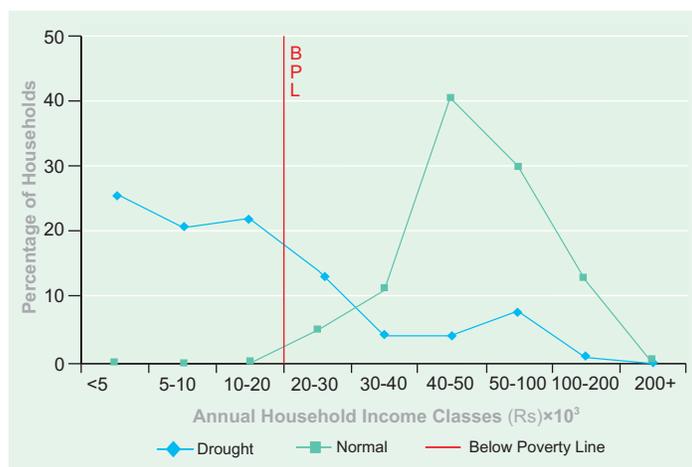
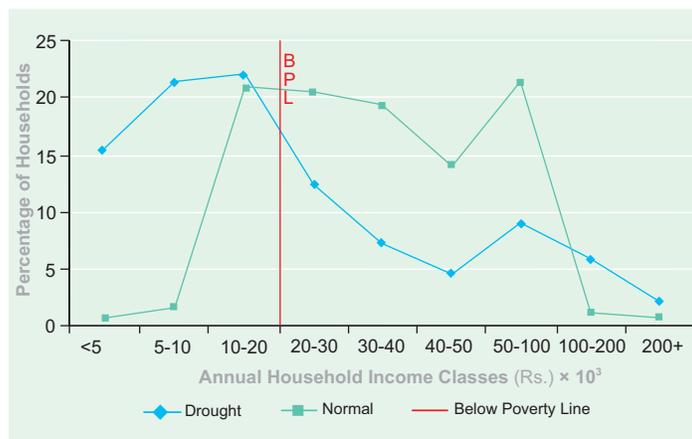


Figure 24: Change in Income Distribution Drought and Normal Years, Bhuj



## BOX 3 Crop Failure and Changes in Livelihood Options During Droughts

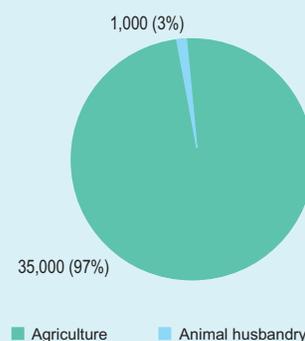
The loss of crops and subsequent changes in cropping patterns as a result of drought and groundwater depletion has been extensive in most villages in Gujarat. Those who still have access to some water have restricted cultivation to subsistence and fodder crops, and eliminated produce destined for the market as in the case of Vijesinh described here, they have been forced to give up an important source of revenue for their families.

Vijesinh has a small family of five, including his aged mother, his wife and their two children. They live relatively well in a *pakka* house with a concrete roof, brick walls and a cement floor. He has five acres of land, which used to be irrigated from a dug well. The well was deepened to 80 feet when the water level dropped in 2000. After deepening the well, Vijesinh was able to get water for 3-4 months but could not irrigate all of his land. In 2001, he installed a 120-foot borehole in the well, at a cost of IRs 35,000, which he borrowed from a moneylender in Satlasana at three per cent monthly interest. He still has not repaid the principal amount, but does pay the moneylender IRs 1,000-2,000 whenever he can. Moneylenders aware of the current cash flow problem and knowing that later, when the situation improves, they will recover their loans with interest in Satlasana are not putting too much pressure on their customers.

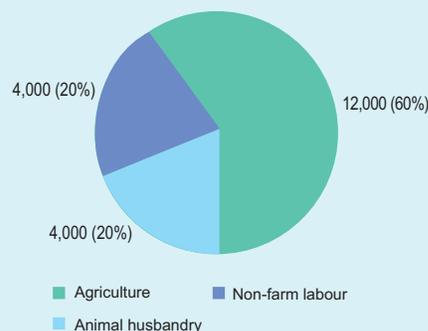
Following the general cropping pattern in the village, Vijesinh initially cultivated groundnut, *bajra* and castor during the monsoon; castor, wheat and fodder in the winter and *bajra* during the summer. Before 1998, he cultivated all of his land and left none fallow. Since then, however, groundwater levels have dropped dramatically and he has been forced to reduce the area under cultivation. The area of wheat, which requires large amounts of irrigation water was cut back first in 2000 when the groundwater level dropped drastically. By 2001 he could only cultivate half an acre of wheat, one acre of castor and half an acre of fodder (*rachka*). In 2002, there wasn't even enough water to cultivate fodder.

In 1999, Vijesinh had eight animals: four buffaloes, two bullocks and two calves. In 2001, he sold the two bullocks for IRs 5,000 and used the money to buy fodder. However, there was a severe shortage of fodder that year and he eventually sold his cows for a token IRs 500, just to make sure they would stay alive. With the collapse of agriculture, animal husbandry had become a significant source of income for family, but later even this source dwindled. Non-farm labour was becoming an increasingly important source of income.

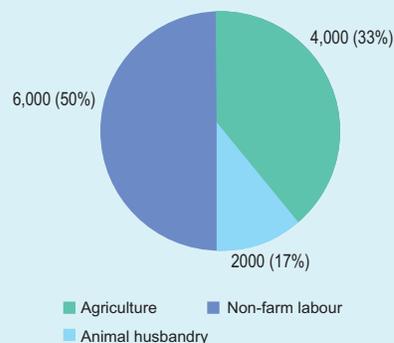
The changes and relative significance of these livelihood options over the drought period, from before the drought in 2000 through 2003, are shown in the accompanying pie charts. As can be seen, returns from agriculture decreased while those from non-farm labour increased progressively. Earlier, the Vijesinh family used to sell only a small quantity of milk to the dairy co-operative and home consumption was high. This trend was reversed over the early years of drought. By 2003, however, milk production had decreased significantly because of the sale of productive. This accounts for the reduced earnings from animal husbandry. Despite increased wage labour, overall income levels also dropped significantly, from IRs 36,000 before the drought in 1998 to IRs 12,000 in 2003.



1998 – Total income: IRs 36,000



2000 – Total income: IRs 20,000



2002 – Total income: IRs 12,000

Government of India defines the poverty line in rural areas as an earning level of IRs 363 per month or IRs 4,356 per year and the World Bank places it at approximately one dollar per day or IRs 16,000 per year. Using a slightly more generous definition of IRs 20,000 per year as an indicator for our purposes, the impact of drought and declines in agricultural income on the extent of poverty become clear. In the case of Satlasana, no families were below the poverty line before the drought. However, almost 69% of the households were pushed below the poverty line and another 14% were reduced to the IRs 20,000 to 30,000 income bracket. In Bhiloda, the percentage of households below the poverty line remained more or less constant. There is, however, strong evidence that the intensity of poverty within this group increased.

The number of households reporting incomes of less than IRs 5,000 per year increased from one per cent to 19%. In addition, approximately six per cent of those initially above the poverty line fell below it during the drought years. In Bhuj, 59% of the population fell below the IRs 20,000 poverty line during the drought years; in normal years only 23% are categorised as poor. Furthermore, of those below the poverty line during the drought, 37% had incomes of less than IRs 10,000 annually; in comparison, only two per cent earn so little during normal years. It is important to recognise that in Bhuj, most of this decline in income is probably not related to the drought but to the earthquake. Bhuj is a chronically

drought affected area where people depend heavily on non-farm income sources such as handicrafts and tourism, both of whose markets declined severely after the earthquake of 2001.

Despite the general adverse changes in poverty indicators in all areas, the impacts on higher income classes differed substantially. In Satlasana, where virtually all households depended on agriculture before the drought, the number of households with incomes above IRs 100,000 decreased from 13 in the normal years to just one in drought years. In contrast, the number of high income households in Bhiloda remained constant. In Bhuj, the number increased from two in normal years to eight during the drought. The existence of stable or increasing incomes levels among the wealthy in Bhuj and Bhiloda is partly attributable to drought relief programmes and partly to the role of these families in providing services such as well drilling, sale of agricultural inputs, and tanker contracts for government and NGO relief activities. In Bhuj, the number of households in the income category above IRs 200,000 increased from two per cent in a normal year to nine per cent during the drought. Most are engaged in the service sector (government and private) and they probably benefited from earthquake relief.

**Vulnerability and gender:** The clear increase in poverty associated with drought appears to have had a major impact on vulnerable populations, particularly women and children. Analysis of data from the primary survey

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**In terms of the primary occupation, there was a clear shift from agriculture to animal husbandry and toward non-farm sources of income as a consequence of groundwater depletion and drought.**

indicated that the consumption of vegetable, milk, ghee and oil declined drastically. Overall expenditure on food consumption declined by 70% in Satlasana and by 26% in Bhiloda. Bhuj showed a slight (nine per cent) increase in food consumption expenditure (around IRs 200 per month), which is probably associated with the post-earthquake relief programme.

**The clear increase in poverty associated with drought appears to have had a major impact on vulnerable populations, particularly women and children.**

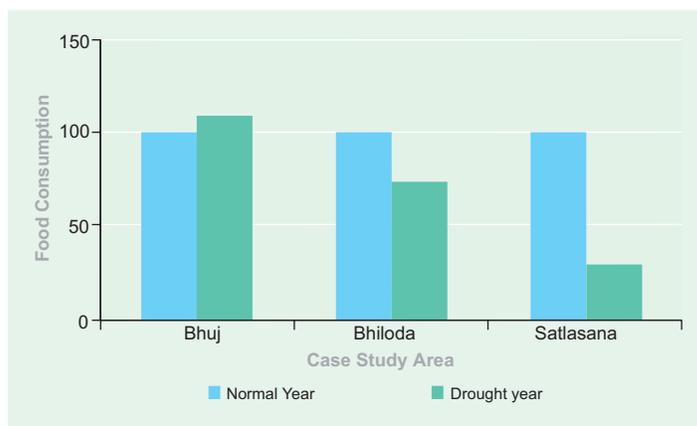
Women and particularly girls generally eat last and are expected to reduce their food consumption substantially during hard times. This may have had a major impact on the health of women and girls. Social impacts were also significant, particularly with respect to marriage. According to local practices, the total expenses for marriages range between IRs 47,000 and 175,000 depending on dowry levels, which are influenced by caste, sub-caste and other requirements. Since many parents find it difficult to mobilise this kind of money, marriages are either postponed or conducted very early, when girls just reach puberty and less dowry is expected. Drought may also have an

impact on decisions regarding the birth and maintenance of girl children.

The female/male sex ratios found in the primary survey are as follows: Bhiloda: 928/1,000; Bhuj: 965/1,000; Satlasana: 920/1,000. These levels, while significantly different from natural ratios, are not substantially different from those found throughout Gujarat. Among younger age groups, however, the sex ratio has declined significantly. For children up to five years of age the sex ratio in Bhiloda is: 717/1,000; Bhuj: 855/1,000; and Satlasana: 756/1,000. In Satlasana, the sex ratio in the age group of 6 to 14-years-old is 662/1,000. The sex ratios in Bhiloda and Satlasana are particularly unfavourable to girls and in the next decade the composition of their populations is going to become highly skewed.

It was not possible to explore the reasons behind the declines in sex ratios in a systematic manner during this study. Interviews with villagers in which this topic came up did indicate, however, that selective biases against girls are particularly strong during droughts. In addition, when incomes decline substantially, as they did in all areas but particularly in Satlasana, incentives to abort female fetuses to avoid the high cost of marriage may increase. This bias is also consistent with the occasional and difficult-to-verify comments of villagers regarding an increase in the sex trade during the droughts as a result of impoverishment. Gujarat has a history of female foeticide and infanticide. As it is one of the more prosperous industrial states in the

Figure 25: Food Consumption Differences between Drought and Normal Years



country, access to sex selection technology is now widely available even in small towns and peri-urban areas despite the official ban on amniocentesis. While the links between drought as a long-term disaster and the declining sex ratio need to be explored further, it is not premature to conclude that environmental and livelihood stress coupled with already strong social preferences for male children have an adverse impact on girl children.

In addition to the above impacts, major reductions in education occurred during the drought. Children (both boys and girls) were put to work on construction sites and enrollment levels declined significantly.

### Local perceptions regarding the cause of drought

Perceptions regarding the nature and cause of drought are a central factor in determining the response of local populations to it. These perceptions differed substantially in different case study sites. While most of the population attributed the drought to

natural or economic factors, as high as 43% of the respondents in Bhiloda and 28% in Satlasana said they believe that the drought was related to religious causes. Beyond this, in Satlasana and Bhiloda, most attributed the drought to absolute shortages of water, which includes declines in groundwater availability, rather than just declines in rainfall. Fodder shortages and shortages of food were seen as key indicators of drought in all areas although the intensity of concern over food was far higher in Bhiloda (65%) than in Satlasana or Bhuj. In Bhuj, almost half the population described the drought in terms of reduced sources of income, a fact that reflects their dependence during normal years on handicraft, tourism, wage labour, animal husbandry and other non-farm income sources and the regular (4-6 years out of 10) nature of drought. The percentage of people in Bhiloda and Satlasana who considered income decline as the primary indicator of drought, while still significant, was much lower. In these two areas drought is less frequent, groundwater was, until

**Perceptions regarding the nature and cause of drought are a central factor in determining the response of local populations to it.**

Table 10: Perceptions Regarding the Cause of Drought in Gujarat

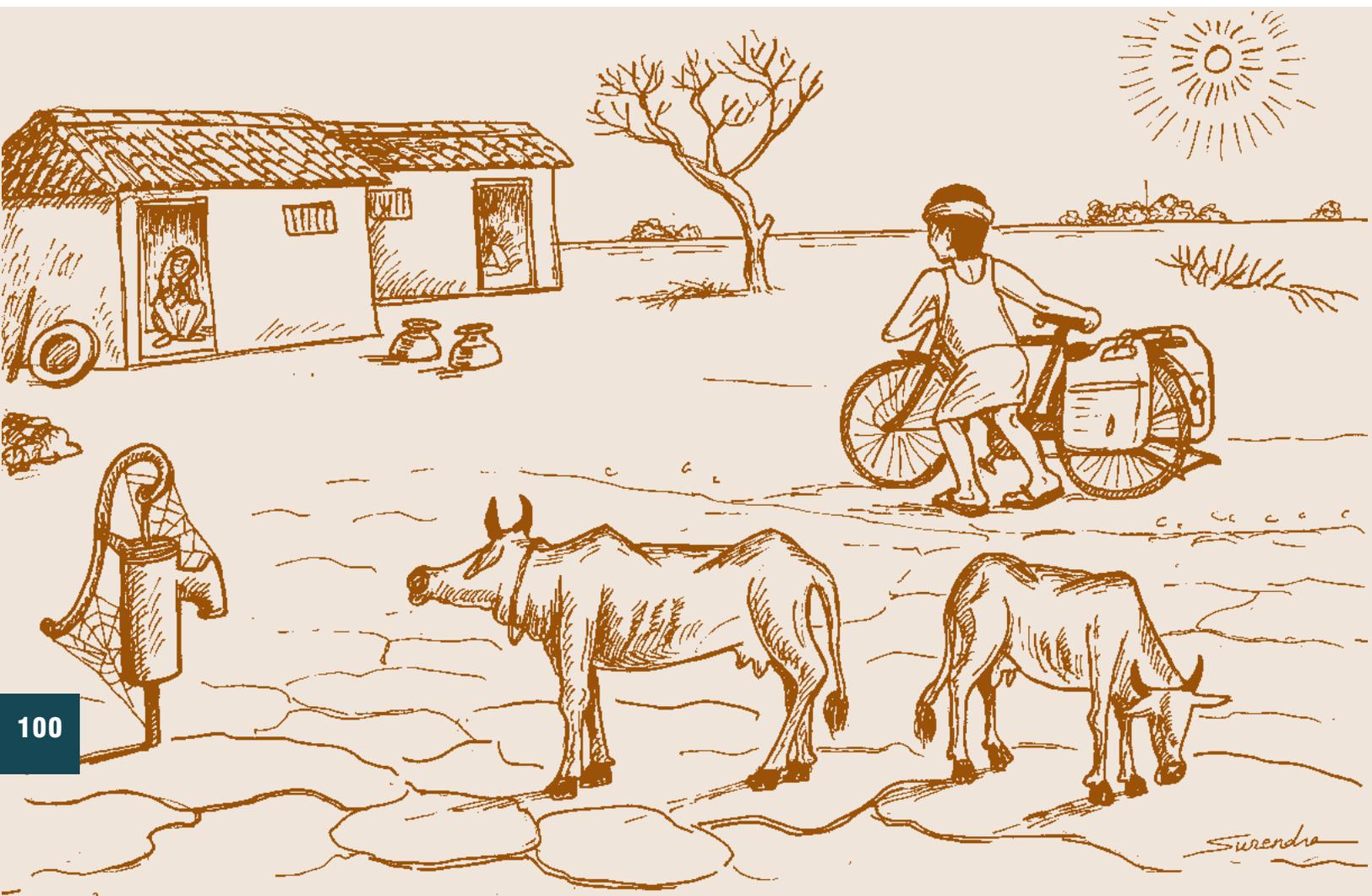
Perceptions	Bhiloda		Perceptions	Bhuj		Perceptions	Satlasana	
	No.	%		No.	%		No.	%
Shortage of water	80	80	Insufficient rain	120	60	Shortage of water	90	90
Shortage of food	65	65	Reduced source of income	89	44.5	Insufficient rain	53	53
Fodder shortage	57	57	Shortage of food	85	42.5	Fodder shortage	30	30
Insufficient rain	28	28	Fodder shortage	35	17.5	Shortage of food	28	28
Reduced source of income	26	26	Shortage of water	33	16.5	Price Hike	20	20
Reduction in yield	9	9	Reduction in yield	12	6	Reduced source of income	14	14
Increase in population	1	1	Others	7	3.5	Reduction in yield	5	5
Reduced income from milk	1	1	Increase in population	1	0.5	Reduced income from milk	2	2
Price hike	0	0	Price hike	0	0	Others	1	1
Others	0	0	Reduced income from milk	0	0	Increase in population	0	0

**Local populations do not link water scarcity with the increases in the numbers of wells and volume of groundwater pumping.**

recently, available and agricultural and natural resource-based livelihoods dominate. Increases in population and in demands on the natural resource base were not seen as major factors contributing to drought in any of the areas. This is important because it strongly suggests that local populations do not link water scarcity with the increases in the numbers of wells and volume of groundwater pumping that have been recorded in locations such as Satlasana over recent decades. In Satlasana, groundwater declines are widely recognised (and indeed ‘shortage of water’ is defined as the primary cause of drought) but this is attributed to natural (lack of rainfall) or religious reasons rather than to increased use.

### Adaptation, Issues and Observations

Differences between the case study areas point toward some of the fundamental factors affecting the ability of populations to adapt effectively to drought. Satlasana was, in many ways, the most clearly affected by the drought. Although initially well off (none of the population fell below the poverty line), the population depended heavily on irrigated agriculture and was poorly equipped to shift when drought and groundwater overdraft combined to eliminate this as a primary livelihood option. Bhiloda was the next worst affected. Although the percentage of the local population below the poverty line did not increase dramatically, the depth and intensity of



poverty, however, did increase: during the drought, 19% reported incomes of less than IRs 5,000 per year and 65% reported a shortage of food as their primary concern. Residents of Bhiloda did not lose as much stored capital as did people in Satlasana and they were able to buffer their livelihoods by drawing on available forest resources, but this, substitution did not fully compensate for reductions in agriculture. Where Bhuj is concerned, the impact of the drought is difficult to separate from that of the earthquake. Because many of its livelihood sources are not dependent on water availability, in the absence of the earthquake the impact of drought alone would probably have been relatively minor. Overall, the drought appears to have had the greatest effect on the lower-middle income group whose livelihoods depended on agriculture.

**Key strategies:** How did people adapt to or cope with drought? A series of common strategies emerged in most of the case study areas. The primary ones were diversification of income sources, reductions in consumption and expenditure. Income diversification was pursued in the following ways.

- *Increased focus on animal husbandry:* As already noted above, in Satlasana despite declines in water availability, most residents attempted to maintain their livestock and overall milk production actually increased. In Bhuj and Bhiloda, focus on livestock has increased, particularly small ruminants such as goats and sheep. The ability of villagers to do this

depended heavily on access to fodder through markets and, in the case of Satlasana, on support from the local dairy cooperative.

- *Increased dependence on wage labour:* In all areas, as agricultural opportunities declined, families sought wage labour as a major source of income. Many, although not all, of these opportunities were in non-farm activities such as diamond polishing, construction and drought-relief works. Although it was not possible to explore this in detail during the survey, interviews with local residents suggest that the poor, who depend on wage labour during normal years may have been better placed to take advantage of wage labour opportunities than better off, middle income farmers were.
- *Increased migration:* The importance of migration as a central strategy for coping with drought emerged early in the survey. It is important to recognise though that while some migration was driven by drought, much of it followed pre-existing patterns. In many cases, migration for work is a central strategy households use in normal years to obtain access to jobs and diversify income sources. Income sent home by migrants provides a critical buffer during drought periods.
- *Increased involvement of women in the labour force:* Drought compelled some women to work

**The importance of migration as a central strategy for coping with drought emerged early in the survey.**

as wage labourers. In Bhiloda 50% of women involved in labour activities. In Satlasana, although the culture of the predominantly Darbar and Prajapati communities limits women's ability to work as labourers outside their own lands, a small percentage (4%) did so. Women from Bhuj, a majority of whom remain at home doing household work and making handicrafts, were also forced to take up labour as the handicraft market dived due to the earthquake of 2001. In Satlasana, women engage in animal husbandry and agricultural labour on their own land. In Bhiloda, all animal husbandry is taken care of by women and 98% work as labour. In 24% of cases, their earning serve as the primary source of income and in 75% as a secondary source. In Bhuj, women serve, multiple roles simultaneously: 30% are engaged in animal husbandry, 34% in agriculture labourers and 63% in non-agricultural labourers.

- *Development of non-agricultural livelihood sources:* This strategy is most evident in Bhuj where frequent droughts limit the viability of agriculture as a primary source of income. Instead, the population has developed an economic system centred around animal husbandry, handicrafts, tourism and trade. In Satlasana and Bhiloda as well, the development of non-farm livelihood systems was central to

the ability of families to maintain their income levels during drought periods. The diamond polishing industry is an important employer (Box 4).

It is important to recognise that the ability of communities to adapt their income sources as outlined above depends on a variety of key higher level factors. The availability of water supplies from local wells, water markets or government financed drinking water schemes was important in meeting fundamental requirements for drinking. Where income is concerned, increased dependence on animal husbandry, to take an example, was only possible because of the existence of regional markets for fodder. Without the ability to transport fodder to other locations such as Satlasana, animal husbandry would have depended primarily on local sources, which were also affected by the drought. The presence of regional cooperatives also played a major role. Activities such as diamond polishing, the handicrafts markets in Bhuj and the ability to access non-farm wage labour opportunities also depended heavily on transport and communication systems. Large-scale, long-distance migration did not occur because populations were often able to access non-farm sources of income locally or within a relatively short (almost commuting) distance. This said, migration did play a major role in the ability of families to ensure a steady supply income during the drought and it is necessary to examine and the role of credit in somewhat more detail.

**It is important to recognise that the ability of communities to adapt their income sources depends on a variety of key higher level factors.**

## BOX 4 The Diamond Polishing Industry: Gujarat's Saviour During Drought

During times of drought in Gujarat, diamond polishing, a labour-intensive industry, tides people over. In Satlasana alone there are seven diamond polishing units that employ over 1,100 people.

Ten to fifteen years ago, diamond polishing was more lucrative than government jobs and even attracted educated young people. Recently, however, the industry has been facing strong competition from Singapore and China, thereby reducing the profitability and quantity of work available in India. Many polishing units have closed down.

There are about 30 licensed diamond dealers in the country, but they all operate informally. Transactions are never documented and are conducted entirely based on trust. Often, custom officials conduct raids and confiscate large amounts of unaccounted for diamonds and cash. Sometimes dealers simply vanish with huge profits. It is low-level operators, who suffer the greatest losses. Currently the diamond polishing industry in India is in recession.

In good times, an expert diamond polisher can earn about 300 rupees a day. Right now, however, they are making at most 50-75 rupees a day, with ever-increasing competition. Many are leaving the industry. If a diamond polishing unit closes down, over 100 people can instantly be put out of work.

Despite the above problems, with the collapse of agriculture due to groundwater depletion, diamond polishing is a good alternative source of income. While at least half of all diamond polishers would go back to agriculture if the monsoon were good and groundwater levels improved, until that occurs, diamond polishing is a saving grace in Satlasana. It provides a critical source of income that is not affected by drought conditions.

- India earns Rs 100 billion per year in foreign exchange through diamond processing and controls 80-90% of the total world diamond polishing market.
- India earns Rs 7.9 billion per year from exporting diamonds.
- India has 800,000 workers in the diamond polishing industry.
- 100,000 workers have lost their jobs in the current recession.
- China has emerged as a major competitor in the international market. It currently has 100,000 diamond polishing workers.
- China is encouraging Indians to set up diamond polishing units in China. Five Indians have already done so.

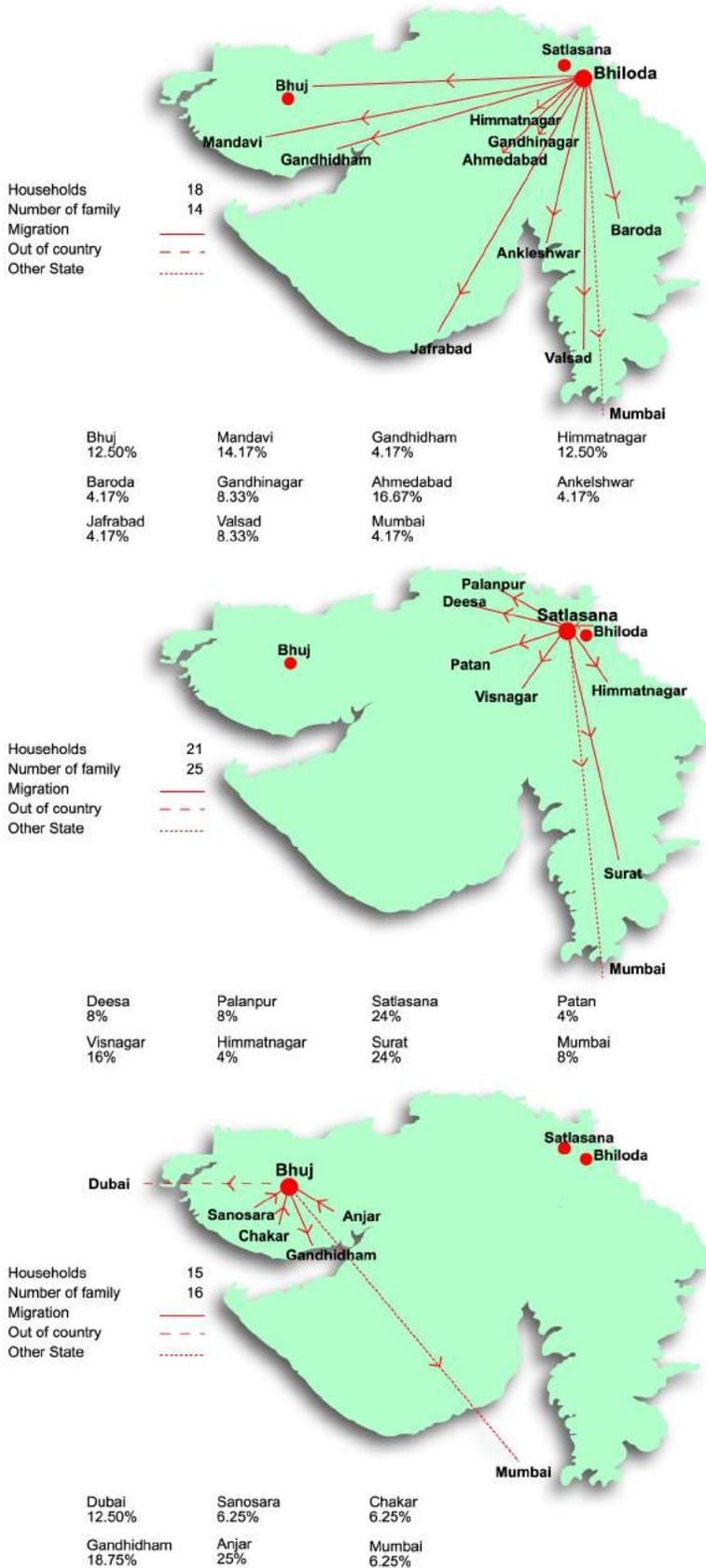
*Source: The Outlook, July 2003*

**Migration and adaptation:** The role migration played in enabling local communities to adapt to drought is important to recognise. Much migration is not related to the 'push' of the recent drought but instead reflects increasing economic opportunities outside of rural villages. Take the case of Satlasana, where 8.67% of the total male worker in the sample households have migrated 'permanently' and now

live and work in other regions. Remittances from these workers return to the village and play an important role as a source of income in some households during periods of crisis. In addition to these permanent migrants, over 21% of the working population of Satlasana area migrates on a temporary basis (for less than six months a year) to adjacent regions and an additional 20.16% commutes at

**Migration is not only related to the 'push' of the recent drought but instead reflects increasing economic opportunities outside of rural villages.**

Figure 26: Migration Status in Bhiloda, Satlasana and Bhuj



least part of the time to the nearby town centre.

Patterns of migration are somewhat different in the other two case study areas. In Bhuj, many people migrate locally to do construction work in Anjar or to work in the shipyards in Gandhidham. They also migrate to Mumbai and to the Gulf. In Bhiloda, most migration is to locate employment as agricultural labours; it is relatively long-distance but confined within Gujarat. These different patterns are outlined in figure 26.

A key point to recognise is that much of the migration is not ‘internal displacement’ due to the drought but instead represents engagement with regional labour and non-farm livelihood opportunities on an on-going basis. This engagement provides a critical source of income for many families during drought years but is often not driven by drought *per se*.

**The role of credit:** A final element to emphasise in the Gujarat case is the role that credit plays in adaptation to and coping with drought. In all the case study areas, as table 11 indicates, many families needed access to credit to meet a range of expenses.

Loans were frequently taken to buy food and pay for medical expenses. In Satlasana a large number of loans were also taken to install bore wells. Virtually all loans were taken at high

rates of interest from informal sources such as moneylenders. In some cases, such as investments in bore wells, loans were taken to invest in activities which, from a technical perspective were unlikely to be productive. In contrast, some loans, such as those for ‘consumption,’ were essential if families were to be able to migrate for jobs. Loans are also essential for many income generating activities, such as fodder purchases, for which formal sources of credit are unavailable. The limited availability of loans from formal sources for activities that could contribute to income (such as migration for work), the high interest rates charged by informal sources and

Table 11: Loans Taken During Drought in Gujarat

Loans taken for purpose	Bhiloda	Bhuj	Satlasana
To meet household needs	47	23	19
To meet medical expenses	6	3.5	2
To construct house/shop	3	1	-
To purchase fodder	2	0.5	1
To purchase livestock	2	1.5	-
For motor purchase	2	-	-
To purchase tractor	1	-	-
To meet marriage expenses	2	3	-
For business purpose	1	2.5	-
For bore well	1	-	7
For agriculture	-	-	1
For education purpose	-	0.5	-

investment in unproductive assets probably compounded the adverse impact of the drought on the level of poverty in the case study areas.

**Migration represents engagement with regional labour and non-farm livelihood opportunities on an on-going basis.**



Measuring the sediment deposits in Bhanavas Check Dam.

## Rajasthan

The case study of Rajasthan differs fundamentally from that of Gujarat. In Rajasthan our goal was to explore on a widespread differences in household strategies among regions rather than, as we aimed to do in Gujarat to generate micro-level insights into strategies at the community level.

### Characteristics of the Region

Rajasthan is a drought-prone state where over 60% of the geographical area is arid and the remaining 40% is semi-arid. Rainfall averages between 50 mm in western districts to 750 mm in southern districts. Differences in average rainfall do not, however, predict drought probabilities.

The case study of Rajasthan differs fundamentally from that of Gujarat.



An analysis of ninety-nine years of meteorological data (Table 12) shows that, despite the much higher total average precipitation, the standard deviation in the southern and eastern regions is higher. As a result, there is not much difference in the total number of drought years among regions. On average, meteorological drought occurs in 45.5% of years (see Table 13). Severe and very severe drought years occur more frequently in the southern and northern districts of Rajasthan than in the western districts.

Government expenses on drought relief measures have been increasing at current prices over each Five-Year plan from an initial level of IRs 2.26 million

Table 12: Variation in Rainfall (1901-1999) in Rajasthan

	Mean	Std. Deviation	Variance
<b>Western Region</b>			
Barmer	265	169	64
Jaisalmer	185	111	60
Bikaner	284	130	46
Nagour	350	182	52
Jodhpur	367	180	49
<b>Northern Region</b>			
Churu	343	159	46
Sikar	478	198	41
Jhunjhunu	400	149	37
<b>Eastern Region</b>			
Jaipur	602	234	39
Ajmer	542	210	39
Swai madhopur	818	359	44
<b>Southern Region</b>			
Udiapur	618	191	31
Bhilwara	578	256	44
Chittore	801	259	32
Dungarpur	728	265	36
<b>Overall</b>	<b>555</b>	<b>146</b>	<b>26</b>

in the First Five-Year Plan to IRs 1,137.64 million in the Ninth Five-Year Plan (See table 14). The rise in expenditure may reflect both growing concern within the central and the state governments for drought-prone areas as well as a gradual shift away from long-term sustainable development measures to short-term relief. Whatever the cause, the increase suggests the ineffectiveness of the existing responses and the growing challenge of meeting basic livelihood needs in arid areas. Furthermore, as table 15 indicates, drought impacts on human and livestock populations are present in most years even when there is no official drought. A better understanding of the factors contributing to droughts and their impacts on livelihoods in Rajasthan is essential.

### Methodology

To understand the impact of drought across the different socio-economic, cultural and agro-ecological zones of Rajasthan, we conducted an extensive survey using multi-stage stratified random sampling techniques. The state was divided into four broad agro-economic and cultural zones (desert, northern/Shekhawati, eastern and southern/tribal) (See table 16). The districts within each zone were listed and one *tehsil* was randomly selected from each district from village *tehsil* maps obtained from the Census of India District Handbook. Following this, one village was randomly selected from each *tehsil*. Each sample village was then visited and a complete listing of all the households that included caste and land holding information was

Table 13: Frequency of Drought and Intensity Between 1901 and 1999, Rajasthan

District	Intensity of drought				% of Years
	Very Severe	Severe	Moderate	Light	
<b>Western</b>	10	12	11	11	44.4
Barmer	3	15	17	11	46.9
Jaisalmer	6	12	13	17	49.9
Bikaner	8	12	16	10	46.5
Nagaur	2	17	15	14	49.0
Jodhpur	5	16	15	18	54.5
<b>Northern</b>	11	8	11	15	45.5
Churu	8	10	7	17	42.9
Sikar	4	20	11	14	49.5
Jhunjhunu	9	15	12	11	47.5
<b>Eastern</b>					
Jaipur	9	11	15	9	45.0
Ajmer	6	16	20	12	44.3
Tonk	9	11	9	14	44.3
Swai Madhopur	8	8	13	18	48.0
<b>Southern</b>	9	12	9	11	41.4
Bhilwara	3	9	9	13	36.6
Chittorgarh	9	12	8	12	42.3
Udaipur	8	15	14	6	43.9
Dungarpur	8	16	9	5	38.8
<b>Overall</b>	<b>9</b>	<b>9</b>	<b>15</b>	<b>12</b>	<b>45.5</b>

Table 14: Plan Expenditure on Drought Relief, Rajasthan

Plan/Years	Drought Relief Expenditure IRs (10 <sup>6</sup> )
i. 1951-56	22.6
ii 1956-61	6.096
iii 1961-66	70.738
1966-67to1968-69	347.752
iv 1969-74	1,720.977
v 1974-79	263.36
1979-80	166.23
vi 1980-85	3,741.681
vii 1985-90	12,383.274
1990-92	485.792
viii 1992-97	7,322.162
ix 1997-2002	11,376.383

Source: Government of Rajasthan, 'Memorandum on Scarcity', Relief Department, Jaipur, November 2000.

prepared. From this list, 10% of the total households, up to a maximum of 40 households and ensuring a representative selection of caste and landholding groups were randomly selected. In the end, primary data was collected from 18 districts, 18 villages and 446 households after designing and pre-testing a set of household

questionnaires. Village-level primary and secondary information and *Tehsil* level secondary data were also obtained through village meetings and from published and unpublished records of the state government.

### Impact of Drought

The impact of drought on sample houses is shown in table 17. Families responded to reduced income levels by selling assets such as land, jewelry and vehicles. Indebtedness increased substantially across all regions and families lost substantial numbers of livestock. Many families had to purchase water. What we discovered replicates the trends found throughout Rajasthan. In a recent *akal* (drought) survey, 40% of households reported having to purchase water.<sup>2</sup> Differences between regions and caste groups were not substantial. It is important to note, however, that the level of debt increased to a much higher levels as a portion of annual income for lower income groups than for the wealthy. In the income group earning less than IRs 12,000 per year, the average depth incurred was IRs 8,560 or 71% of the maximum annual income. In contrast, families earning up to IRs 30,000 annually had debts averaging 35% of the maximum level income and families in higher income groups ran up debts 20-30% greater than their income. Only higher income groups sold land but it is likely that lower income groups had little land to sell. Their proportionally higher indebtedness combined with the sale of jewelry and other assets indicates that they were much more heavily affected by the drought than higher income groups.

Table 15: Impact of Drought, Rajasthan

Year	District affected (%)	Population affected		Food grain Production Index
		Human (%)	Livestock (%)	
1970-71	26.92	1.35	2.28	140.24
1971-72	50.00	17.30	8.79	100.52
1972-73	100.00	52.77	47.37	81.84
1973-74	0.00	0.00	0.00	106.65
1974-75	96.15	56.02	NA	78.99
1975-76	0.00	0.00	0.00	12.27
1976-77	0.00	0.00	0.00	118.85
1977-78	73.01	34.54	29.49	113.58
1978-79	100.00	15.59	41.10	124.12
1979-80	100.00	86.45	NA	83.26
1980-81	100.00	59.48	58.39	103.08
1981-82	96.30	64.63	66.76	113.66
1982-83	96.30	60.23	63.14	132.08
1983-84	11.11	0.75	NA	159.87
1984-85	77.78	27.38	26.74	125.58
1985-86	76.30	70.44	61.40	125.88
1986-87	100.00	82.54	65.96	107.76
1987-88	100.00	92.27	74.98	76.25
1988-89	62.96	11.44	20.15	170.57
1989-90	92.59	35.35	32.34	135.40
1990-91	0.00	0.00	0.00	173.50
1991-92	100.00	74.60	66.24	126.64
1992-93	40.00	10.87	8.89	182.14
1993-94	83.00	56.00	54.35	111.94
1994-95	0.00	0.00	0.00	185.81
1995-96	93.55	62.47	59.09	151.81
1996-97	67.74	14.37	15.20	203.44
1997-98	75.00	11.27	NA	222.67
1998-99	62.50	48.83	54.42	205.23

Source: Government of Rajasthan, Relief Department, Jaipur.

Table 16: Sample Households by Region and District in Rajasthan

Regions	Districts	Tehsil	Panchayat Samiti	Selected Village	Number of Sample Households
Desert Region	Barmer	Barmer	Barmer	Ramderia	23
	Jaisalmer	Jaisalmer	Sum	Kanoi	30
	Bikaner	Nokha	Nokha	Ninyadeshwar	25
	Jodhpur	Osiya	Osiya	Bara Khurd	30
	Nagaur	Jayal	Jayal	Khanwar	21
Northern Region	Churu	Sardarshahar	Sardarshahar	Mitasar	20
Shekhawati Region	Jhunjhunu	Nawalgarh	Nawalgarh	Niwai	30
	Sikar	Fatehpur	Fatehpur	Nayabas	30
Eastern Region	Jaipur	Dudu	Dudu	Khudeyala	20
	Ajmer	Kekri		Sarsunda	20
	Sawai Madhopur	Bauli	Bauli	Bapui	30
	Tonk	Malpura	Malpura	Sans	27
	Dausa	Lalsot	Lalsot	Dungarpur	22
Southern Region	Bhilwara	Banera	Banera	Banskalya	20
Tribal Region	Chittor	Bhadesar	Bhadesar	Parleya	30
	Rajsamand	Rajsamand	Rajsamand	Phiyaudi	21
	Udaipur	Jhadol	Jhadol	Chechlaya	19
	Dungarpur	Sagwara	Sagwara	Gudhaveganiya	28

### Adaptation and Coping Strategies

Within Rajasthan and other parts of India, the coping strategies households use to respond to drought are relatively well known. They commonly involve the following:

1. growing a mix of crops and/or rearing a variety of livestock;
2. entering the labour and tenancy markets as needed;
3. drawing on stored goods or selling fixed assets;
4. adjusting consumption of food and other goods;
5. borrowing;
6. drawing upon traditional social networks; and
7. seasonal or, if necessary, longer-term migration.

The above coping strategies can be grouped in three broad categories: (i) *risk minimisation*, involving crop and herd dispersal, non-farm income diversification, and accumulation of assets and savings; (ii) *risk absorption*, involving the sale of livestock and non-productive assets, a search for new sources of income, and collection of debts; and (iii) *risk taking to survive*, involving reduced consumption, the sale of productive assets, and reduced socialisation. Since wealthier households generally have more assets, greater access to credit and other social support, and more non-farm income than do the poor, they are better able to maintain their level of consumption during drought related crises.

People use a variety of coping strategies that minimise risk, absorb risk or involve risk-taking to survive.

While analysing livelihood strategies it is essential to recognise that rural people are not just farmers; they also include factory workers, miners, and farm labourers, crafts people, traders and so on. Different people at different stages of their lives adopt different livelihood strategies. The social and economic worlds that influence decision-making at local levels go well beyond the farm gate and include networks of social relations. They are also affected by national economic policies and conditions, international economic trends, price levels, market functioning and levels of infrastructure and service support.

The coping strategies adopted by sample households to deal with drought in different sections of

Rajasthan have been shown in table 17. Most households adopted multiple strategies that included risk absorbing and risk taking. Involvement in wage labour was common across all regions. Reducing consumptive expenditures on social functions, rituals, and even food combined with borrowing from friends, relatives and banks were the primary strategies reported in all the regions. Migration and sale of livestock and livestock products were also common and were adopted on average by 33% of the population. Approximately 23% of the sample household reported changing their livelihoods and 21% reported using past savings (stocks of food and fodder and cash savings). Mortgaging land was relatively uncommon in the desert and northern regions but was a strategy utilised by

**Different people at different stages of their lives adopt different livelihood strategies.**

Table 17: Impact of Drought on Sample Households, Rajasthan

Item	Indebtedness (IRs/HH)	Sale of Assets (%)			No of Livestock		Adjusting Food	Diversi-fication of Liveli-hood
		Land	Jewelry	Vehicle	Sold	Dead		
<b>Region</b>								
Desert	26,099	0	75.0	25.0	67	555	98.3	34.1
Northern	19,029	33.3	0	66.7	28	112	100.0	17.5
Eastern	28,692	12.5	87.5	0	129	126	96.9	20.2
Southern	29,682	25.0	50.0	12.5	11	65	98.7	16.9
<b>Caste Group</b>								
General	26,973	100.0	0	0	12	310	100.0	26.4
SC	10,689	0	100.0	0	17	122	98.1	28.6
ST	17,525	0	60.0	20.0	17	42	95.2	14.6
OBC	37,179	15.4	61.5	23.1	189	376	100.0	22.4
<b>Income Group (000 Rs)</b>								
<12	8,560	0	50.0	25.0	30	181	97.7	18.8
12-30	10,436	0	90.0	10.0	69	311	98.8	25.4
30-60	13,238	33.3	50.0	16.7	45	138	100.0	23.6
60-100	29,084	50.0	0	50.0	64	125	96.0	30.4
Above 100	1,03,607	100.0	0	0	27	93	100.0	15.2
<b>Overall</b>	<b>26,350</b>	<b>17.4</b>	<b>60.9</b>	<b>17.4</b>	<b>235</b>	<b>858</b>	<b>98.4</b>	<b>22.9</b>

roughly 5.8% of the population in eastern and southern regions. Beyond these strategies, responses such as the sale and mortgaging of trees, moving family members and animals to relatives in less affected areas and turning to bonded labour in exchange for food were commonly mentioned. Each of these strategies is discussed in more detail below.

**Credit and indebtedness:** On average, slightly over 50% of the sample households reported that borrowing funds to meet their needs was a major coping strategy. Detailed information from the survey reported in table 18 indicates that much of the borrowing was concentrated in SC<sup>3</sup> and lower-income households. Most (56%) of the loans were from moneylenders (Table 19) banks were the second largest source (38%) and relatives played a relatively minor role (six per cent). The rate of interest charged by private moneylenders ranged between 18% and 36% annually in comparison to the 12% to 16% charged by the banks. Survey indicate that OBC<sup>4</sup> households are more indebted than other castes are (Table 20). Backward castes and lower-income groups generally depended more on moneylenders and had less access to funds from banks than did higher income and non-backward caste groups. This is true despite all the welfare and target oriented programmes and schemes resumed for SC, ST and OBC households.<sup>5</sup> These categories of households and the poor are primarily dependent on exploitative sources of loans, i.e. moneylenders. Information on the amount borrowed by households

from different sources indicates, however, that moneylenders are important for all income categories (Tables 19 and 20).

**Use of grain and fodder stocks:** Stocking foodgrains and fodder during good crop years and accumulating other assets that can be sold when necessary is a common practice in the arid and semi-arid areas of Rajasthan. Few households, though are able to save cash. Traditionally, many households had their own fodder and foodgrain banks to cope with drought. This practice, while still important, has declined as public distribution systems and communication and road networks have reduced the requirement for them. Over 20% of the households in our survey reported using this strategy to manage during droughts. Adoption of the strategy varied significantly by region: 50% of the sample households in southern region adopted it in comparison to slightly over 20% in other regions. This is probably due to the greater ability of households in the southern region to accumulate significant stockpiles during good years as a result of the generally higher agricultural productivity in that region.

**Sale of assets:** Among poor households distress sales of assets is a common practice for coping with drought. Surveyed households reported having sold jewelry, houses, vehicles, land, and other assets. In most regions, jewelry is the most commonly sold asset with vehicles second in the northern region. Where road networks are good, families may be starting to invest less

### Indebtedness

#### increased

substantially across all regions and families lost substantial numbers of livestock during the drought.

Table 18: Drought Coping Strategies (Percentage of Households)

Strategy	Regions				Overall
	Desert	Northern	Eastern	Southern	
Borrowing	57.4	48.8	54.6	50.8	53.4
Use of grain and fodder stocks	21.7	21.3	25.2	50.8	21.5
Sale of assets	3.1	5.0	7.6	6.8	5.6
Lowering consumption	49.6	61.3	56.3	66.1	57.8
Sale of livestock	33.3	31.3	44.5	23.7	33.4
Sale of livestock products	17.1	21.3	26.9	16.1	20.2
Left agriculture for wage labour	79.5	50.0	45.8	55.0	62.7
Migration	45.7	33.8	27.7	25.4	33.4
Changing livelihood	33.3	17.5	21.0	16.9	22.9
Sale or mortgage of trees	3.1	6.3	7.6	4.2	5.2
Mortgaging land	0.8	3.8	10.1	8.5	5.8
Others	14.0	12.5	13.4	9.3	12.3
<b>Overall</b>	<b>(100.0)</b>	<b>(100.0)</b>	<b>(100.0)</b>	<b>(100.0)</b>	<b>(100.0)</b>

in jewelry and more in vehicles as they are not only high-value and easily sold but also productive. Land sales are relatively common but there was substantial variation among regions. In the desert region, for example, much of the land is not private and that which is has a low value due to its limited use for agriculture and other purposes. As a result, sales of land were not found in this region.

Drought directly affects household consumption as food items and cash are rendered unavailable. Adjustments in consumption include reductions in food intake and changes in the composition of food baskets. In order to save, many families cut down on the consumption of edible oils and vegetables. They also reduce expenditure on education and health. Analysis by region, caste, and income group indicated that adjusting household food consumption was more

widely practiced than withdrawing children from school or compromising on health. Overall, 10.8% of households reported removing children from school so that they could become earning members of the family. The number of households reporting the use of child labour was more in northern and southern regions than elsewhere. All castes and income category’s exercised this strategy to cope with the drought. At village-level meetings and in group discussions, the removal of girl children from school was identified as a common practice particularly in the southern and northern regions and among low-income groups.

**Sale of livestock and livestock products:** Changing the type of livestock owned and selling livestock and their products are common drought-coping strategies. Despite the adjustments, many animals, particularly cattle and small ruminants, died during the recent drought. Primary

**Borrowing funds to meet survival needs was a major coping strategy.**

data from our survey indicate that 446 household lost a total of 1,093 animals, of which 637 (58%) were goats and sheep, the traditionally most resilient and mobile forms of livestock. Poor households lost more cows and small ruminants as a percentage of the total livestock owned than did other income groups. This was probably because they could not afford the high cost of fodder available in regional markets. Households with large land holdings also lost substantial numbers of all types of animals.

**Mortgaging assets (land, household assets, jewelry, trees, etc.):** Mortgaging assets in order to obtain funds for consumption requirements during periods of drought is a relatively common practice in many rural areas mostly those in the eastern and southern regions. A total of 5.8% of the households in our survey, reported using it. Land and jewelry are the assets most commonly mortgaged. Of the households who mortgaged assets, 90% mortgaged only land, 5% only jewelry and 5% both land and jewelry. Because the drought of 2003 was preceded by three consecutive drought years, many families reported that they had lost assets due to non-payment of loans.

**Social capital (using kinship ties):** Documenting the role of kinship relationships in coping with drought would have required a substantially longer interaction with the surveyed households than was possible. Sample households were contacted once only for detailed interviews. Despite the limited time available to explore this

Table 19: Loans Taken to Meet Drought Needs (Percentage of Households)

Item	Sources			Overall
	Formal source (Banks)	Money lender	Relatives	
<b>Regions</b>				
Desert	34.6	56.4	9.0	100.0
Northern	33.3	66.7	0.0	100.0
Eastern	44.4	53.1	2.5	100.0
Southern	38.2	52.9	8.8	100.0
<b>Overall</b>	<b>38.3</b>	<b>56.1</b>	<b>5.6</b>	<b>100.0</b>
<b>Caste</b>				
General	60.5	39.5	0.0	100.0
SC	31.3	65.6	3.1	100.0
ST	42.6	48.9	8.5	100.0
OBC	32.5	59.7	7.9	100.0
Muslims	0.0	100.0	0.0	100.0
<b>Overall</b>	<b>38.3</b>	<b>56.1</b>	<b>5.6</b>	<b>100.0</b>
<b>Income Group (*000 INC)</b>				
<12	29.3	62.7	8.0	100.0
12-30	36.9	57.1	6.0	100.0
30-60	30.6	65.3	4.1	100.0
60-100	52.8	41.7	5.6	100.0
100 - above	64.0	36.0	0.0	100.0
<b>Overall</b>	<b>38.3</b>	<b>56.1</b>	<b>5.6</b>	<b>100.0</b>

Table 20: Amounts Borrowed from Different Sources (IRs) (Average per borrowing household)

Item	Amount Borrowed by Source (IRs)			Overall
	Bank	Money lender	Relatives	
<b>Regions</b>				
Desert	9,222	16,877	Negligible	26,099
Northern	11,386	7,643	Negligible	19,029
Eastern	21,033	7,659	Negligible	28,692
Southern	11,893	13,622	4,167	29,682
<b>Caste</b>				
General	14,173	12,800	Negligible	26,973
SC	6,060	4,629	Negligible	10,689
ST	4,424	6,852	6,250	17,525
OBC	24,233	12,946	Negligible	37,179
Muslims	Negligible	Negligible	Negligible	
<b>Income Group (Thousands)</b>				
<12	4,017	377	4,167	8,560
12-30	4517	5918	Negligible	10,436
30-60	11,800	1,438	Negligible	13,238
60-100	10,084	19,000	Negligible	29,084
100 - above	54,863	48,744	Negligible	1,03,607
<b>Overall</b>	<b>14,319</b>	<b>10,246</b>	<b>1,786</b>	<b>26,350</b>

issue, 12.3% of households reported they had sought help from relatives. In some cases this involved direct loans but in many other cases it involved help finding jobs or providing other non-financial forms of support. This strategy was common across the region in all economic classes and castes.

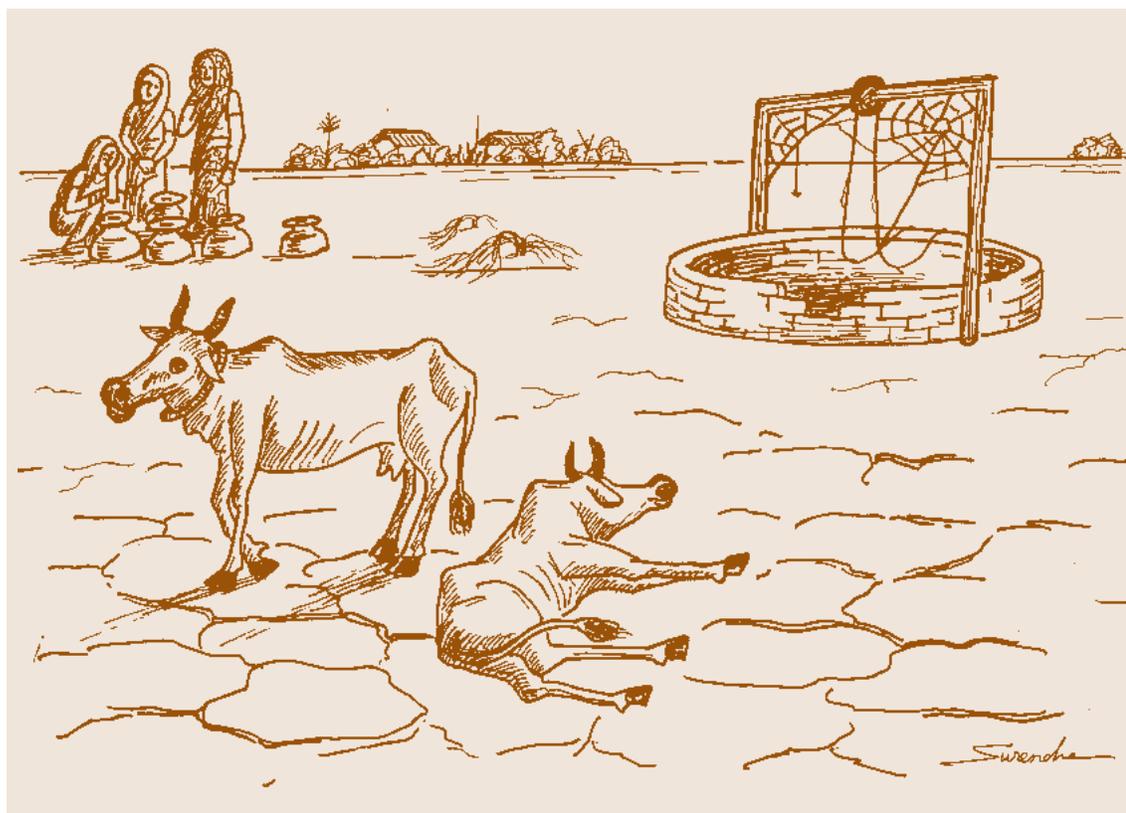
**Changing occupation/livelihood systems:**

Sixty-two per cent of the households covered in our survey reported changing their occupation from agriculture to casual wage labour as a major mechanism for maintaining income levels during the drought period. In addition, another 20.6% left their primary occupation and started doing business within or outside their villages. In some cases adopting this strategy involved a complete shift. In one village near Udaipur, for example, one group of villagers developed a regional business selling ice cream in

nearby cities during the hot season. This generated more income for the families involved than they were able to earn through agriculture. In the desert region, many villagers from traditional farming castes have taken up wood working. The variety of strategies for income diversification into non-farm occupations was difficult to categorise based on the information gathered from the primary survey but increased involvement in non-farm livelihoods clearly represented a major mechanism for coping with drought in all areas. Diversification of occupation was practiced by all castes and income categories and in all the regions.

**Human migration:** Migration of Rajasthan men and women in search of employment and food both within and outside the state is a common feature during droughts<sup>6</sup>. As table 21 indicates, migration can be of short or long

**Among poor households distress sales of assets is a common practice for coping with drought.**



duration depending on the employment opportunity and household characteristics and may involve travel within the district, movement within the state or movement outside of the state. The locations to which people migrate are affected by a large number of factors. Short distances within the state are almost always preferred to long-distance migration. With improvements in communication and road networks, however, the number of constraints has decreased. About 33% of the households surveyed reported that one or more family members had migrated. Migration was most prevalent in the lowest- income groups in the western region. Migration periods of six to nine months are most

common. Long-term migration for more than a year was reported by just 6% of households. The distance migrants traveled from their homes depended largely on the availability of employment opportunities; overall, almost 40% of migrants were reported to have left the state. There were major regional differences in migration patterns. In the eastern region 76% of migrants stayed within the state, while in the southern region 62% of migrants traveled outside, mostly to Gujarat. Only two cases of migration outside the country were reported; both of these were in the northern region. Muslims and other groups from this area commonly migrate to Gulf countries, mostly as unskilled workers.

**Households reported migration and changing their occupation from agriculture to casual wage labour as a major strategy for maintaining income levels during the drought period.**

Table 21: **Short and Long-term Drought-migration Reported by Sample Households, Rajasthan**

Item	Migrated hh%	Migration Type								Total	
		Short-Term		Long-Term		Within District	Within State	Outside State	Outside Country	Male	Female
		< 3 months	3 to 6 months	6-12 months	>1 year						
<b>Region</b>											
Desert	45.7	5 (6.2)	15 (18.5)	53 (65.4)	8 (9.9)	22 (27.2)	21 (25.0)	38 (46.9)	-	78	3
Northern	33.8	8 (24.2)	6 (18.2)	17 (51.5)	2 (6.1)	7 (21.2)	6 (18.2)	18 (54.5)	2 (6.1)	31	2
Eastern	27.7	17 (25.4)	14 (20.9)	36 (53.7)	- (0.0)	10 (14.9)	51 (76.1)	6 (9.0)	-	48	19
Southern	25.4	7 (20.0)	10 (28.6)	15 (42.9)	3 (8.6)	11 (31.4)	2 (5.7)	22 (62.9)	-	34	1
Overall	33.4	37 (17.1)	45 (20.8)	121 (56.0)	13 (6.0)	50 (23.1)	80 (37.0)	84 (38.9)	2 (0.9)	191	25
<b>Caste</b>											
General	40.3	3 (7.5)	6 (15.0)	28 (70.0)	3 (7.5)	7 (17.5)	10 (25.0)	23 (57.5)	-	38	2
SC	33.0	10 (16.7)	8 (13.3)	39 (65.0)	3 (5.0)	9 (15.0)	34 (56.7)	17 (28.3)	-	44	16
ST	28.1	11 (39.3)	10 (35.7)	3 (10.7)	4 (14.3)	12 (42.9)	7 (25.0)	9 (32.1)	-	26	2
OBC	33.9	13 (14.8)	21 (23.0)	51 (58.0)	3 (3.4)	22 (25.0)	29 (33.0)	35 (39.8)	2 (2.3)	83	5
Muslims	0.0	0 (0.0)	- (0.0)	- (0.0)	- (0.0)	-	-	-	-	0	0
Overall	33.4	37 (17.1)	45 (20.8)	121 (56.0)	13 (6.0)	50 (23.1)	80 (37.0)	84 (38.9)	2 (0.9)	191	25
<b>Income Group ('000 IRs)</b>											
0-12	23.9	18 (58.1)	8 (25.8)	2 (6.5)	3 (9.7)	14 (45.2)	7 (23.6)	10 (32.3)	-	28	3
12-30	31.2	12 (21.1)	13 (22.8)	30 (52.6)	2 (3.5)	14 (24.6)	15 (26.3)	28 (49.1)	-	51	6
30-60	46.1	4 (6.5)	7 (11.3)	44 (71.0)	7 (11.3)	15 (24.2)	19 (30.6)	28 (45.2)	-	57	5
60-100	37.5	2 (4.9)	6 (14.6)	33 (80.5)	- (0.0)	4 (9.8)	27 (65.9)	10 (24.4)	-	33	8
100-above	34.8	1 (4.0)	11 (44.0)	12 (48.0)	1 (4.0)	3 (12.0)	12 (48.0)	8 (32.0)	2 (8.0)	22	3
Overall	33.4	37 (17.1)	45 (20.8)	121 (56.0)	13 (6.0)	50 (23.1)	80 (37.0)	84 (38.9)	2 (0.9)	191	25

Note: Numbers in parenthesis are percentage.

Migration patterns by region, caste and income group were also analysed. As expected, the absolute number of migrants was highest in the desert region and lowest in the northern and southern regions. The southern, eastern and northern regions are all adjacent to major urban areas and to productive regions such as Gujarat, Haryana and Delhi where jobs are available. This is less true in the eastern area, where migration outside the state is lower. With the exception of ST migrant, who generally migrate for short periods, most migrants in all four regions (56%) stayed away from home between six and twelve months. In general, lower income households prefer to migrate for shorter periods of time than middle-income households. The types of work available for migrants vary significantly by region. In the desert region, large-scale state investments are currently being made in canal irrigation, which provides substantial employment opportunities. Employment opportunities are also available in areas irrigated by these projects. Other major sources of employment in the state involve mining and quarrying, construction work, and service in urban areas. In general, only male family members migrate except in a very few poor households where women migrate along with male members.

### Summary

The Rajasthan case study clearly indicates the close inter-linkages between long-term development, adaptation to climatic variability and coping with drought. The households interviewed in

the survey employed a mixture of strategies. Some were basic coping mechanisms involving reductions in consumption and sale of assets in order to meet survival needs. A second spectrum of responses involving migration, livelihood diversification and livelihood change, link coping and adaptation. In some cases, migration was a 'push' strategy forced upon households in order to meet survival needs. In other cases, however, households moved to locations where employment opportunities provided better sources of income or were attracted (as in the case of the ice cream sellers and woodworkers) to new, highly remunerative, income generating activities. Their ability to access these new opportunities appeared to depend on a variety of infrastructure, such as banking systems and road and communication networks, that had been created through long-term development initiatives. Overall, migration and livelihood diversification into non-farm (whether business or wage) activities clearly emerged as important strategies for both coping and adaptation.

Some of the worst impacts of the drought occurred where infrastructure was lacking. Households that, for example, mortgaged key assets to moneylenders to meet immediate consumption requirements often lacked the resources to migrate and obtain productive employment. They also lost key assets when they were unable to repay mortgages.

**Diversification of occupation was practiced by all castes and income categories and in all regions.**

## CASE STUDIES OF FLOODS

The case studies of flood presented in the report cover two basins, the Rohini and the Bagmati in Nepal and India.

Although the impacts of flooding are fundamentally different from those of drought, in many instances the responses followed by local populations are similar. The discussion of the case studies in Nepal is presented first, followed by the India studies.

### NEPAL: the Rohini and the Bagmati<sup>7</sup>

In Nepal, researchers explored flooding in the Bagmati and Rohini basins. The former is located in the Central Development Region while the later is in the Western. The Bagmati River originates in the Mahabharat range of the Himalaya and flows into the Tarai at Karmaiya (see maps in page 118 and 119). In Rautahat District, it is joined by its major tributary Lal Bakaiya, which originates in the Chure (lower Shiwalik range). Then the augmented river flows along the western part of the district near the Nepal-India border. The Rohini is a tributary of the West Rapti River, which flows into the Gandak River north of Gorakhpur in India. In Nepal, the Rohini basin drains parts of Rupandehi and Nawalparasi districts. Floods in both the Bagmati and the Rohini basins damage houses, crops, farmland, and other assets as well as animals and humans.

### Methodology

The case study is based on a survey and analysis of 1,008 households in different portions of the two river basins. The

characteristics of the surveyed households are shown in table 22.

The population surveyed totaled 6,230. The average family size was 6.24, which is higher than the national, western and central Tarai averages of 5.75, 6.06 and 5.86 respectively. In the Bagmati basin the population density is 484 per square kilometre while that in the Rohini it is 521. Both figures are higher than the average population density of the Tarai (330 persons/km<sup>2</sup>).

The sex ratios in the two basins are balanced (49 m/f and 52 m/f respectively). A significant number of households, about 37%, are female headed. About 65% of the population is literate but the majority have not been educated above secondary school. In the Rohini basin, 72% are literate while in Bagmati basin only 54% are literate. Literacy in both areas is below the national average.

Although both districts are part of what is perceived as the grain basket of the country, our data indicate that the Bagmati basin is a food deficit area. Rohini has lower productivity per hectare, but registers a food surplus.

In both areas about 36% of the population has lived in the region for more than 20 years while 64% has migrated in the recent past. Most of the migrants came from the hills or from across the border. Despite the long settled nature of at least part of the

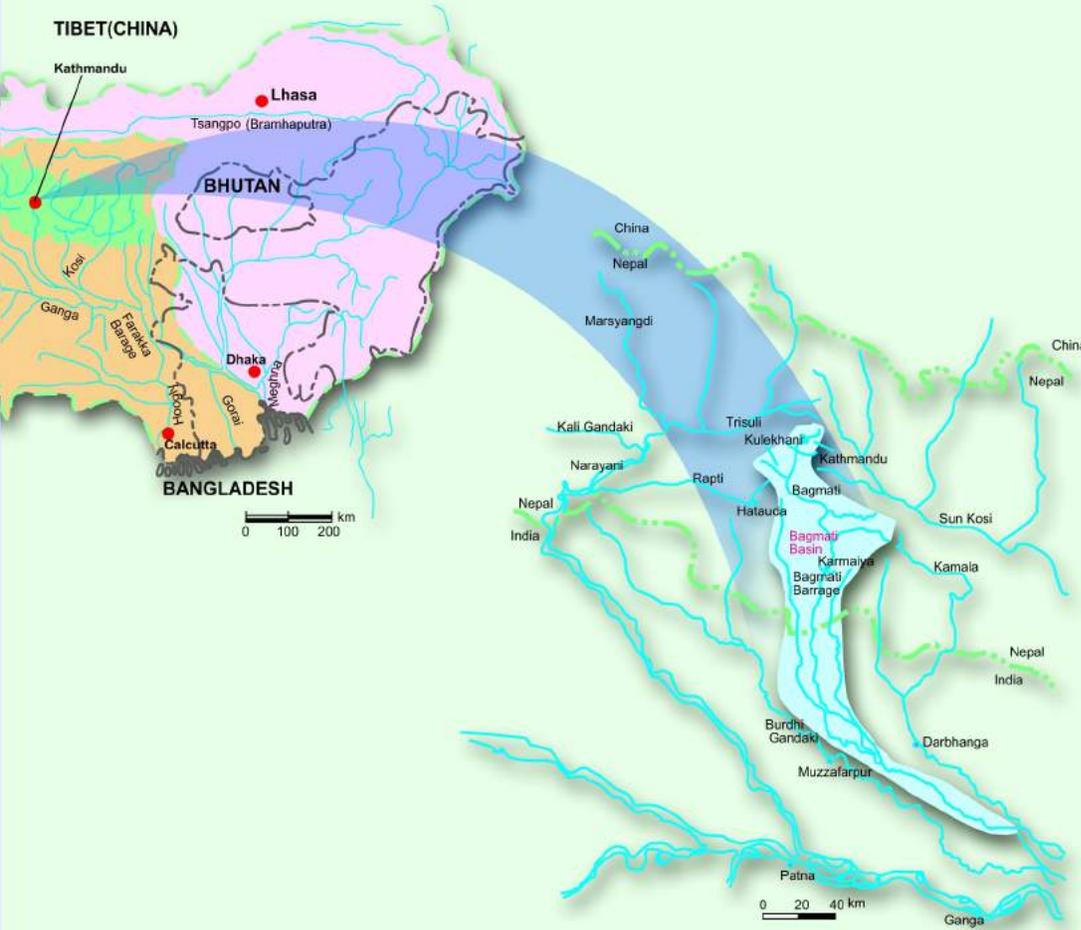
Although the impacts of flooding are fundamentally different from those of drought, in many instances the responses followed by local populations are similar.

Both the Bagmati and Rohini rivers are tributaries to the Ganga. The Bagmati River rises in the Mahabharat hills north of Kathmandu while the Rohini River originates in the Chure hill of Nepal. »

**Rohini Basin: Nawalparasi/Uttar Pradesh**



» The Bagmati joins the Kosi before flowing into the Ganga.  
 The Rohini first flows into the West Rapti, which joins the Ghagara and then the Ganga



**Bagmati Basin: Rautahat/Bihar**  
**RAUTAHT**



Table 22: Characteristics of Surveyed Households, Nepal

River Basin	District	Strata	VDC	Total Households	Sample Households	Remarks
Bagmati	Rautahat	Head	Kanakpur	1,348	104	Mixed group
		Middle	Bhasedwa	814	70	Tarai origin dominated
			Samanpur	1,106	90	
		Tail	Brahmpuri	966	80	
Rohini	Rupandehi	Head	Devdaha	4,355	368	Hill origin dominated
	Nawalparashi	Middle	Devgaun	644	54	Mostly tharu community
			Kerwani	2,294	191	Mixed group
		Tail	Rampur Khadauna	620	51	Mostly Tarai origin
<b>Total</b>	<b>3</b>	<b>3</b>	<b>8</b>	<b>12,147</b>	<b>1,008</b>	

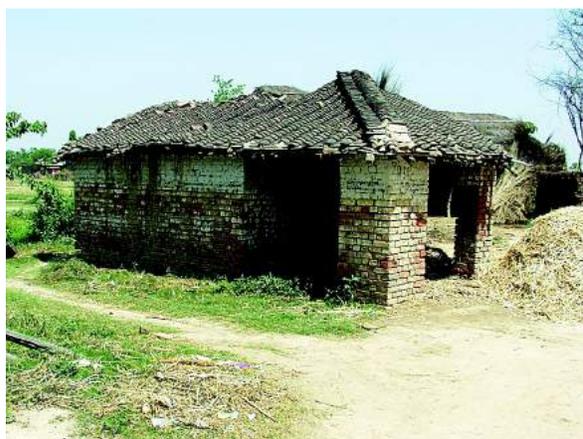
Source: Nepal Sample Household Survey 2003.

**People shift frequently from one place to another in the Bagmati basin due to floods.**

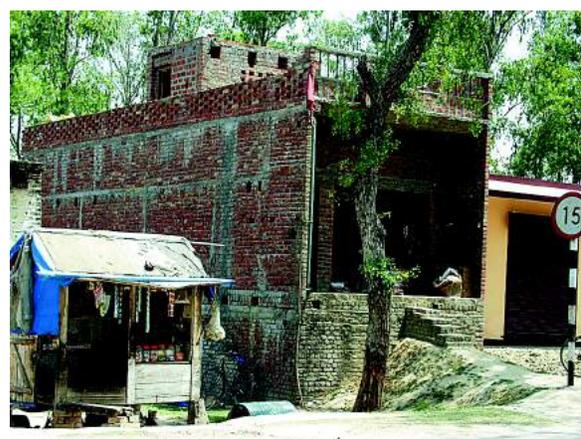
population, large numbers of houses are new - most are not older than fifteen years and about 26% of the houses are less than five years old. This suggests that people shift frequently from one place to another within the basin. The reason given was floods. Over 40% of the houses reported the need for regular maintenance of following annual flood damage.

About 49% of the people in the Bagmati basin own land in flood-prone areas, while in the Rohini basin the corresponding figure is only 34%. Most

households also own land outside flood-affected area. Forty per cent of the sample households in both basins own land in a flood-prone zone while only 28% reported owning agricultural land outside a flood-prone zone. The average landholding size within flood-prone zones is 0.61 hectare compared to 0.66 hectare outside flood-prone zones. The average landholding size both within and outside flood-prone areas is higher in the Bagmati basin (0.91 ha and 0.86 ha) than in the Rohini basin respectively (0.86 ha and 0.57 ha) (See table 23).



Traditional house



Cement brick house with raised plinth height

### Occupation

Overall, only 36% of the population in both basins depends primarily on agriculture. Other common occupations include labour (16.3%), services such as teaching (9.5%) and working in offices. Office work emerged as a major income opportunity following the NGO boom of the late 1980s and has escalated in recent years. A few sample households are engaged in business and a very high proportion of the population depends on wage earnings from areas outside their rural village homes. The degree of income diversification is higher in the Rohini basin than in Bagmati basins (See figures 27 and 28). The populations engaged in agriculture and labour are higher in the Bagmati basin (47% and 36% respectively) than in the Rohini (31% and 7% respectively).

The average yields of crops in the three districts of Rautahat, Nawalparasi, Rupandehi are about the same. Yields are higher in the Bagmati study area probably because regular floods bring fertile soil and the Bagmati has a larger catchment area than the Rohini. Despite the higher productivity, food availability in the Bagmati basin is low and people suffer from food deficiency. There is little crop diversification. Eighty per

cent of the farmers in the Bagmati basin grow late paddy, which is highly vulnerable to flooding and only 20% grow early paddy, whereas in the Rohini basin over 35% households cultivate early paddy. In addition, more families in the Rohini basin grow crops such as wheat, oilseeds, pulses, and vegetables than in the Bagmati. Overall, cropping patterns in the Rohini are more

Figure 27: Rural Occupations

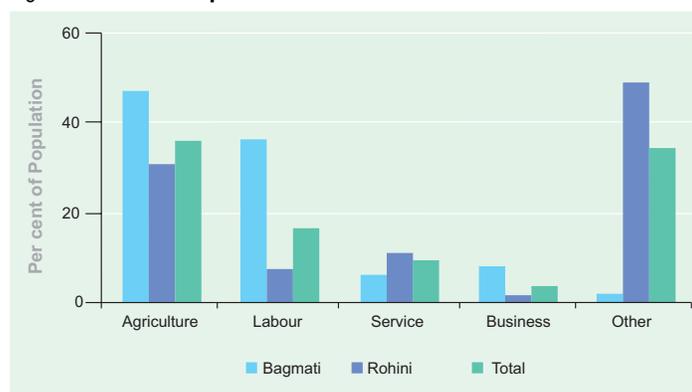


Figure 28: Crop Diversification

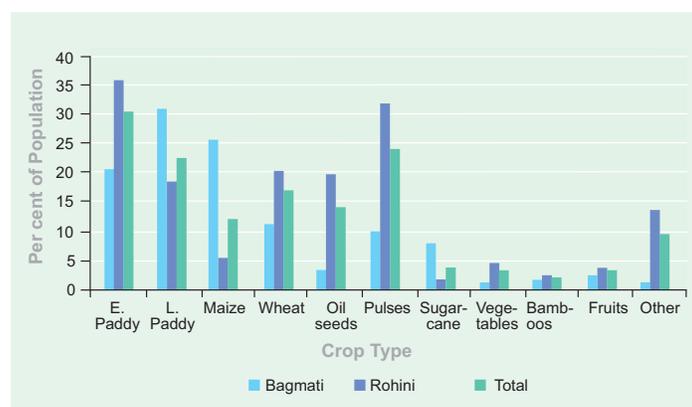


Table 23: Households with Land Ownership

River Basin	Landholding in Flood affected area		Landholding outside Flood affected area	
	Household (%)	Average holding size (ha)	Household (%)	Average holding size (ha)
Bagmati	49.7	0.91	24.0	0.86
Rohini	34.2	0.39	30.0	0.57
Both	39.6	0.61	27.9	0.66

Source: Nepal Sample Household Survey 2003.

diversified and contain more species that are resistant to flood damage. In the Bagmati basin, however, many families still grow crops such as maize which is very sensitive to water logging.

Food sufficiency is greater by almost two months in years when there is no flooding. On average, household production on private lands is sufficient for 6.7 months of consumption in years with no flooding compared to 4.9 months during years of flooding. The level of food sufficiency is higher in the Rohini basin: 9.3 months and 6.1 months in years of no floods and years of flood respectively, whereas the comparable figures in the Bagmati basin are 4.2 and 3.6 months.

People living in the Rohini basin have much more diversified sources of income than those in the Bagmati basin. For 41% people in the Bagmati basin a large proportion of income comes from agriculture (Table 24). Services earn them about 20% of their income. In the Rohini basin agriculture provides only about 14% of income; a major share – about 48% – comes from other sources. Services provide about

27% of their income. Through diversification, people in the Rohini basin are able to earn twice as much as people in the Bagmati basin (Table 24).

Patterns of expenditure in the basins are also remarkably different. Even though incomes are considerably higher, people in the Rohini basin spend only about 40% more than people in the Bagmati basin (Table 25). This indicates that they have the opportunity to save money, a fact reflected in the capital assets they own. The capital assets of both communities are given in table 26. The average income of sample households with diversified occupational strategies is NRs 72,185/household/annum. The major share of income is derived from services (25%) followed by agriculture (22%).

Higher incomes translate into a much greater ability to purchase consumer and other goods. For example, 31% of households in the Rohini basin own radios as opposed to 7% in Bagmati. Ownership of a gas stove, a recent addition to household goods, is also higher in the Rohini basin. A gendered difference in ownership of household items was also found: women in the Rohini basin own items such as radios and bicycles, but those in the Bagmati basin do not.

Livestock is an integral part of the agricultural system and contributes substantially to livelihoods. Communities keep livestock for manure as well as fuel. With the exception of poultry, whose availability is common in the Rohini basin, there was no significant difference

**People living in the Rohini basin have much more diversified sources of income than those in the Bagmati basin.**

Table 24: Average Annual Income of Households

Source	Bagmati		Rohini	
	Income (NRs)	%	Income (NRs)	%
Agriculture	17,862	41.3	14,065	13.9
Livestock	3,334	7.7	6,732	6.7
Service	8,633	19.9	28,007	27.7
Trade/Business	4,279	9.9	2,694	2.7
Cottage Industry	445	1.0	1,001	1.0
Others	8,729	20.2	48,589	48.0
<b>Total</b>	<b>43,282</b>	<b>100</b>	<b>1,01,080</b>	<b>100</b>

Source: Nepal Sample Household Survey 2003.

in the number or type of animals kept by communities. About 50% and 47% of households keep goats in the Bagmati and the Rohini basins respectively while 35% of households in the Rohini basin keep poultry as opposed to only 8% in the Bagmati basin. Women own some animals and often retain their share of the income. Females own about 4% of the animals in both basins but their income from livestock is 26% of the total in the Rohini basin and only 8% in the Bagmati basin (Table 27). This income probably accounts for women's ownership of household goods as discussed above. Livestock, because of the assured income it provides, was frequently noted as a key asset for coping with floods in both basins.

Differences in the income and overall economic development of the Rohini and the Bagmati basins are probably related to long-term structural differences. The town of Bhairahawa in the Rohini basin is a major entry point connecting Gorakhpur, a major town in Uttar Pradesh, with Nepal. This entry point has been used for decades for trade and transit; Nepalis seeking employment in India including jobs in the Indian Army, travel through Bhairahawa. The road from Bhairahawa to Pokhara constructed in the late 1970s also fostered trade, industry, and hotels. In addition, because Lumbini, the birthplace of Buddha, is in the region tourism is substantial. The Bagmati basin does not enjoy these opportunities; in consequence its economy has not flourished so robustly.

Table 25: Annual Expenditure Pattern (NRs/HH/Year), Nepal

Item	Bagmati		Rohini	
	NRs	%	NRs	%
Cereal	16,081	39.5	22,790	40.8
Dal	2,705	6.6	3,161	5.7
Vegetables	2,057	5.0	343	0.6
Spices	884	2.3	1,004	1.8
Kerosene	996	2.2	783	1.4
Gas	88	0.2	234	0.4
Electricity	1	0.0	1,059	1.9
Communication	499	1.1	902	1.6
Transportation	1,537	3.8	3,141	5.6
Medicine	3,566	8.8	5,167	9.2
Education	2,053	5.0	4,305	7.7
Cloth	4,414	10.8	4,765	8.5
Agriculture wage	1,545	3.9	1,804	3.2
Other wages	297	0.7	635	1.1
Festivals	3,291	8.1	3,451	6.2
Others	827	2.0	2,340	4.3
<b>Total</b>	<b>40,751</b>	<b>100</b>	<b>55,884</b>	<b>100</b>

Source: Nepal Sample Household Survey 2003.

Table 26: Ownership of Consumer Goods, Nepal

Goods	Bagmati		Rohini	
	No of Holders	%	No of Holders	%
TV	27	7.8	205	31.3
Radio	110	32.0	318	48.6
Furniture	256	74.4	583	89.1
Bicycle	167	48.5	415	63.5
Motorcycle	4	1.2	12	1.8
Gas Stove	3	1.2	40	6.1

Source: Nepal Sample Household Survey 2003.

Table 27: Share of Female Ownership of Livestock and Income from Animal Husbandry

Description	Bagmati	Rohini
Total livestock number	2,536	9,414
Livestock with female ownership	98 (4%)	976 (4%)
Total income from livestock products	9,20,400	25,30,254
Share of female income (NRs)	70,018 (8%)	6,49,058 (26%)

Source: Nepal Sample Household Survey 2003.

### Flood Events

A long history of flooding in both the Bagmati and the Rohini basins is well established in the memory of local residents.

In the Bagmati region, people recall the flood of 1953 after which many mango trees died. They also recall the flood of 1970, which by depositing massive amounts of soil on their land had a positive impact. In 1972, a canal (*paini*) was extended to the border region and since then the Bagmati has been cutting its right bank. The East-West highway also blocked many streams and rivulets that had drained the Chure range and joined the main as tributaries. Very few openings for drainage are provided along the highway. They are, in fact, inadequate for channeling the runoff from rain in the Chure hills. Following the construction of the highway, many other roads have been built to connect small towns and villages. Some, such as the road connecting the highway and Gaur (the

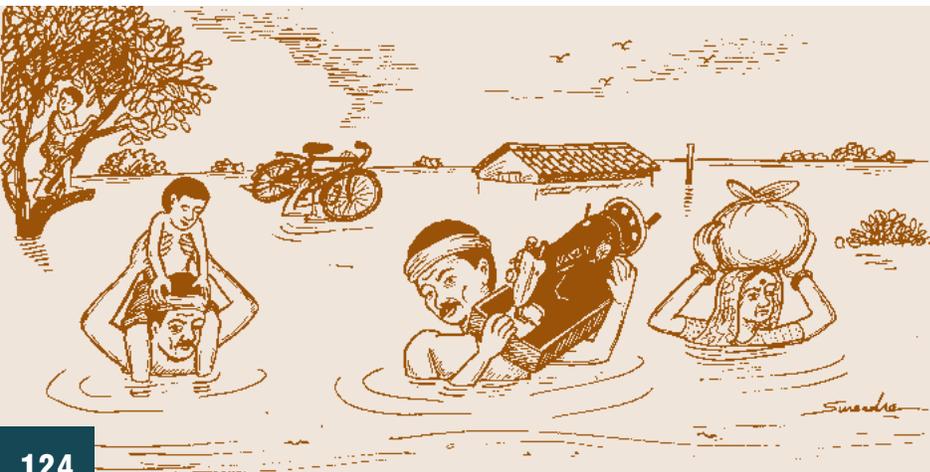
People attribute the increase in the magnitude of floods over the last three decades to anthropogenic factors.

district headquarters in the south of the Bagmati basin), block the floodwater of the Lal Bakaiya River. An embankment built to protect the town of Berganiya in Bihar also blocks drainage and channels floodwater of the Lal Bakaiya to the Bagmati thereby blocking water for a longer period. These new infrastructures have magnified flood impacts in the Bagmati basin.

In the Rohini basin, the duration of natural flooding caused by heavy rainfall has increased since roads and canals were built. Major structures like the canals of the Gandak barrage in Nawalparasi District exacerbate flood damage. Small structures built within the basin to protect a few villages have also blocked the drainage of water from its natural course, causing water to remain within areas that originally were flooded only for short periods.

In the Rohini basin, flooding is commonly regarded as a natural phenomenon but people attribute the increase in the magnitude of floods over the last three decades to anthropogenic factors. Table 28 reveals that majority of sample households (64%) believe that the worst floods have occurred during the last 5 -15 years.

Currently, severe floods generally occur every ten years. The ethno-histories of floods in the Bagmati and Rohini basins that we collected suggest that flood events were not as severe 50-60 years ago. Severity and unmanageability have increased in recent years.



### Difficulties Associated with Flood

During floods water is knee-deep in villages. The floodwater remains for a few days to a few weeks, depending upon the volume of rain. If the floodwater remains only for a day or two losses are generally not significant since crops and grazing grass recover. Local inhabitants do not regard events of such short duration as floods. When inundation occurs for longer periods the damage is greater; sometimes everything submerged is lost.

Floods affect land, crops, livestock and physical infrastructure such as houses and irrigation systems. They also cause substantial loss of human and animal lives. The sample survey revealed that in the last five years, people have lost crops and property worth NRs 30 million. The average loss per household is NRs 30,172. Losses caused by floods are more than three times higher in the Bagmati basin than in the Rohini basin (Table 29). Differences are even higher in relation to annual income. In the Bagmati, the average loss of NRs 53,319 is equivalent to losing nearly 123% of the annual household income once every five years. In contrast, the equivalent of only 17% of annual income is lost every five years in the Rohini basin. Of the total loss 85% is related to crop damage; loss of land accounts for 10%, of houses 3.4%, of livestock 0.8% and other assets 0.7%.

The communities surveyed estimate that total loss of property in the last flood alone was equivalent to NRs 21.24 million and that the average loss

per household was NRs 21,282. The loss per household was almost 10 times higher in Bagmati (NRs 50,576 per household) than the Rohini basin. (Table 30)

Qualitative information also reveals that the impact of a flood can be great. Many ex-landlords have become landless poor due to floods. Rupi Sah of Rautahat, once a ‘mahajan,’ is now a squatter (Box 7).

In addition to the loss of land and crops, floods bring other difficulties.

Table 28: Occurrence of Flooding in the Case Study Area

River Basin	% HHs reporting Year of Flood Occurrence			
	<5 yrs	5-15 yrs	15-25 yrs	>25 yrs
Bagmati	2.1	81.8	7.0	9.1
Rohini	7.5	53.4	25.7	13.4
<b>Total</b>	<b>5.6</b>	<b>63.7</b>	<b>18.9</b>	<b>11.8</b>

Source: Nepal Sample Household Survey 2003.

Table 29: Total Losses Due to Floods Within the Last 5 Years Nepal

Loss Type	Average loss (NRs)/ HH		
	Bagmati	Rohini	Both
Crops	44,837	15,628	25,696
Land	6,534	1,166	3,016
Houses	1,069	983	1011
Livestock	450	130	240
Other	435	91	210
<b>Total</b>	<b>53,319</b>	<b>17,574</b>	<b>30,172</b>

Source: Nepal Sample Household Survey 2003.

Table 30: Households Reports of Total Losses in the Last Flood

Loss Type	Average loss ( NRs)/ HH/ year		
	Bagmati	Rohini	Both
Crops	3,116	1,572	2,104
Poultry bird	224	1.2	78
Land cutting	46,390	4,252	18,776
Other	846	50	324
<b>Total</b>	<b>50,576</b>	<b>5,875.2</b>	<b>21,282</b>

Source: Nepal Sample Household Survey 2003.

Prominent among them are reduced mobility, risk of disease, and insecurity among individuals and families. Feeding families is also a major problem. Beaten rice or *bhujiya* is often consumed during floods since finding dry firewood and a place to cook is a problem. People also mention problems stemming from the lack of toilets and increases in the prices of consumer goods. About 40 - 70 % of households reported having experienced both problems during floods (Figure 29).

**Feeding families is a major problem during floods.**

Daily ablutions pose a particular difficulty when the land is flooded and people cannot locate places to defecate. This contributes to health problems. People living in relief camps often cannot get safe drinking water and are forced to collect muddy contaminated water in a container and let the sediment settle before drinking it. Hand pumps are frequently submerged in floodwaters and people are forced to drink dirty river water for months. Treated water can be rarely found, so people have diarrhea, fever,

cough, and cholera. Snakebites are widespread as both snakes and humans seek refuge in the same high points. In case of wounds and diseases people rely on traditional local medicines, which are often ineffective. For snakebites and jackal bites (which are generally infected) people make efforts to obtain modern medicines but these are rarely available.

Women and children are particularly hard hit by flooding. Feeding children insufficient nutritious food is a major problem and, because they drink contaminated water, they fall sick frequently. Flooding compounds the workload of women, who have the primary responsibility for taking care of children, food and valuables. In many cases they must walk long distances to fetch clean water, food and fuel. Because they eat whatever is leftover after their children and husbands have eaten they also often have insufficient food. In addition, women experience great tensions when they are forced to take refuge in camps or in the houses of friends and relatives. If flood duration is short problems are few but they increase rapidly over time. Because women tend to stay in the place of refuge while men are out seeking work or involved in other activities, the stress of interaction with others in tight quarters during displacement falls mainly on them. Temporary makeshift camps or relief centers lack privacy to change clothes and perform daily ablutions. For days women live in their wet clothes with no opportunity to remove them and allow them to dry. They often can not find an

Figure 29: Difficulties Associated with Floods in the Bagmati



adequate place for sleeping. Much of the time women live separately from men with only children accompanying them. The psychological stress of living in camps or with neighbors or relatives is particularly hard on expectant and lactating mothers.

Aside from the stress of displacement *per se*, women are among the most vulnerable groups during flood times. In Nawalparasi, women reported that they were not harassed by men in the relief camps. This said, some interviewees indicated that displaced families, particularly those with isolated women, were targets for sexual trafficking. While it was impossible to document this connection in detail during the survey, the potential link bears investigation.

Like women children are badly affected and their education suffers greatly. Children miss classes because

schools are forced to close or they are displaced. Many families complained that teachers do not repeat the missed lessons for those absent due to floods. In addition, even young children are often forced to work in order to meet household income requirements.

### Coping During and After Floods

Households in study areas affected by flooding adopt a variety of coping mechanisms and strategies. When floods occur, priorities tend to break down as follows: first families try to save themselves and valuables; secondly, they try to save their food supplies; and third they attempt to save their animals and fodder for them. In cases of severe flooding families release their livestock and move to safe places. How much can be saved is viewed as being dependent on their 'karma' as well as on the type and duration of flood.

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**Some interviewees indicated that displaced families, particularly those with isolated women, were targets for sexual trafficking.**

## BOX 5 New Skill Provides Livelihood

Thirty-years-old Babu Lal is just one of the many Dalits living in Kanakpur village on the bank of the Bagmati who struggle to feed their families two meals a day. He lives with his parents, his wife, and their two children. The sole bread earner in the family Babu Lal works in a zamindaar's fields as a daily wage labourer.

Once, when Babu Lal fell ill and was confined to bed, the family was forced to look for other sources of income. His mother took a loan from a moneylender for his treatment. Then, since Babu Lal could not return to work until he had fully recovered, his parents and wife worked as labourers to make ends meet.

After he recovered Babu Lal learned of training in weaving bamboo chairs. Babu Lal joined the course and learned new skill and now makes a living by making chairs. His wife and mother help him make chairs which sells for up to Rs. 100 a piece. He earns Rs. 150-200 a day whereas earlier as a wage labourer he made about Rs. 3,335 to 4,000 a month. With the additional income, he has been able to open a saving account in a local bank.

He has also paid back the loan his mother took when he was sick and bought some piglets. Learning a new skill has made him more secure financially.

Immediately after the water level starts to rise, people move to higher lands such as natural hillocks, the bunds on irrigation canals, embankments, roads and schools. VDC offices and *pakka* (brick and cement) houses of neighbours and relatives are other refuges. When they need to flee, people take whatever valuables and foodstuff they can carry along with them. Where no elevated places are available, women stack wooden cots and stay on the top. Those who cannot move make a *machhan*, an elevated structure made of bamboo, to stay safe. Constructing a *machhan* is a traditional response used in initial stages of a flood. A *machhan* is, however, inadequate for anything except floods of very short duration and people are forced to shift to other places for long-term refuge. During high floods transportation is difficult and high-elevation refuge may be unavailable. Boats are rare so banana trunks are

often used to transport goods and people through floodwaters.

As flood waters rise, animals are either let loose so that they can move to safer places themselves or, they are deliberately shifted to high ground beneath trees. If a flood comes at night, however, animals sometimes remain tied and die because people are preoccupied with moving valuables. Whenever possible, people take lactating animals with them and cut green paddy, sugarcane or any other crop that is likely to be damaged by the flooding to use as animal fodder. With grazing land under water, lactating animals require a great deal of care.

In addition to simply moving out of the way, local populations have developed a variety of more specific strategies for coping with floods. These include the following:

*Installing elevated hand pump platforms:* Whenever people can afford the extra cost they build elevated versions of standard hand pumps. Most of the existing hand pumps in the case area were installed through NGO and donor-financed drinking water projects. Because all such projects are built during the dry season, almost none have been designed to function during floods.

*Borrowing grain and cash from relatives, landlords and other sources:* People are forced to pay high interest rates on loans, so they avoid borrowing as far as possible and try to manage with whatever food they have.

Once the floodwaters recede, people come back to their houses, clean up, and begin their lives over again.



Use of treadle pumps is gaining popularity in Nepal Tarai.

*Replanting grains, fodder and other crops:* Newly planted paddy is replanted if it is flooded out. People replant as long as seedlings are available and the season allows, but generally give up after the third planting. Likewise, if grazing grass decays, animals must still be fed so farmers either buy hay or find grazing land elsewhere.

*Dismantling and shifting houses from locations where riverbank cutting is occurring:* Bamboo and other materials from existing houses are used to construct makeshift houses some distance away from rivers. Traditional mud-brick houses are particularly vulnerable to flood damage but portions of the material used in their construction can often be saved.

*Social organisation:* In some regions people are starting to organise volunteers to help with rescues and provide other assistance (such as food and medical care) during the floods. This is much more evident in the Rohini basin where the density of government and non-government organisations in the field level is high.

### Post Flooding

Once the floodwater recede, people come back to their houses, clean up, and begin their lives over again. In locations such as the Rohini basin, many households have assets which they rapidly invest in rebuilding houses and livelihoods. In the Bagmati basin, however, most people have limited assets. If they have no food, which is usually the case, they borrow money

and look for employment. Much of the time it is impossible for them to obtain loans because they have no means to pay except what they hope to earn during the next harvest.

Farming in Nepal is primarily a monsoon activity when farmers grow paddy and maize. These crops meet the core subsistence needs of families for most of the year. Since much of the land is not irrigated, many families cannot grow winter crops. When they can, they use small diesel pumps or treadle pumps to irrigate vegetables. Oilseeds and other winter crops are also sown but because reliability of irrigation is poor, production is low. For this reason, food availability is at its lowest point in the year during the rainy season. When flooding cause crops to fail, families must look for other employment in order to sustain themselves until the next crop is harvested, if that is not damaged. Following floods people cannot mortgage their land to get money because it has little value. Thus, the incentive to invest further in farming declines sharply.

Families generally have two options to restore income sources following major flood losses. If they have access to irrigation and can count on growing a

**Traditional mud-brick houses are particularly vulnerable to flood damage.**

Table 31: **Strategies Adopted after Floods**

Strategy	Number of Respondents	
	Bagmati (%)	Rohini (%)
Sale of land	1 (0.2)	2 (0.3)
Sale of ornaments and jewelry	40 (11.5)	3 (0.5)
Wage earning by children	22 (6.4)	14 (2)
Wage earning by adult male and female	44 (13)	80 (12)
Temporary migration	73 (21)	20 (3)

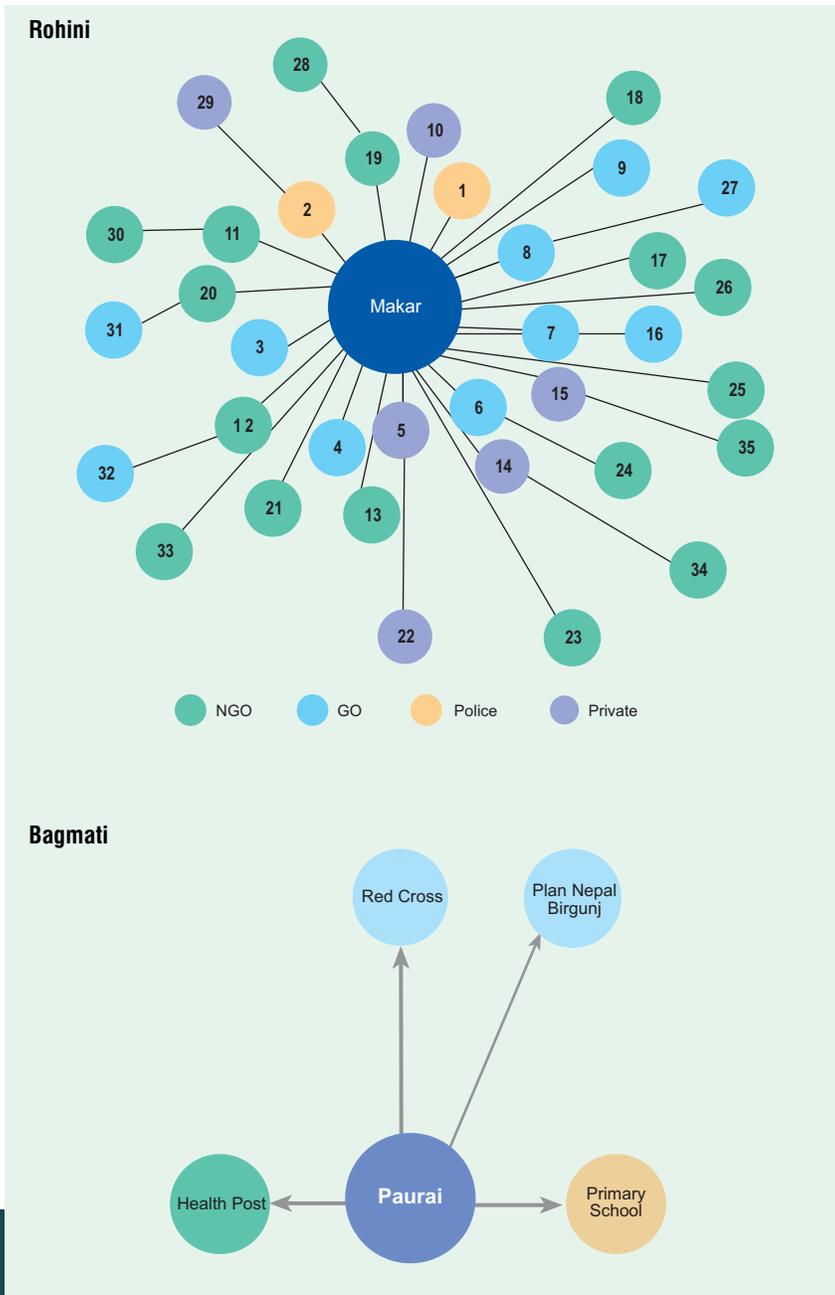
Source: PRA Survey, 2003

winter crop, they borrow food from neighbors to meet their needs for a few months until harvesting time. If they lack access to irrigation most people attempt to find jobs within the village or at a viable commuting distance. If no jobs are available locally they migrate to nearby towns or cities. Not every one has the ability to move far

away. People from the Bagmati basin lack financial resources and are less able to migrate than the people of Rohini basin.

For those who cannot move to other places or find jobs, selling land and gold ornaments is the last resort. As table 31 indicates, jewelry is sold frequently but families avoid selling land.

Figure 30: Institutional Presence in Rohini and Bagmati basins, Nepal



**Factors Influencing Adaptive Capacity**

The population density in the Rohini basin is higher than that in the Bagmati basin and the frequency and intensity of floods is equivalent though bank cutting is less. Even so, the losses are higher in the Bagmati basin. The reason is that in the Rohini basin, much of the population is better equipped to protect their livelihoods because dependence on agriculture is lower and sources of income are more diversified. Furthermore, most houses in the Bagmati basin are of traditional type and are highly vulnerable to flood damage. As a result, 15% of the houses in the Bagmati basin had experienced damages compared to only one per cent in the Rohini basin.

Key factors influencing the ability of people in the Rohini to relatively easily cope with floods include:

1. The large number of people with access to work outside villages and in India;
2. The diversified cropping pattern;
3. The diversified nature of income sources and the fact that many families earn income from services, business and wage labour;

## BOX 6 A Woman Takes Charge

Thirty-two-years-old Bhagya Devi lives in Kananpur village of Rautahat with her two sons, two daughters, husband and mother-in-law. Their main source of livelihood is agriculture. After they lost their land to a flood, her husband went to Punjab to work as a labourer. He returns home every year but spends half of his income on liquor. Much against local traditions, she went out in search of work as a labourer to support her family. Her husband did not help her.

One day robbers attacked her. They raped her and also took away the little jewelry she had. This unfortunate incident devastated her. Not only did the society sneer at her but her husband also rejected her because other men had touched her: he made no allowance of the fact that she was not a consensual partner. The local *panchayat* intervened and advised the couple to stay together. Bhagya Devi consented keeping the interest of her children in mind and her struggle continued because of her young children.

She began planting vegetables on her four *katha* of land. Every day she leaves home for the market with a basket full of vegetables and takes pride in the fact that she brings home some income from the sale. She is not ashamed even to go against the social norms, which require that women veil, themselves. Self-reliant Bhagya Devi inspires other women too. Since she began earning independently, her relations with her husband have improved. He even consumes less liquor now.

4. Enough income to enable households to buy substantial assets, which serve as a source of funds in times of crisis;
5. The presence and degree of access to high-level organisations. In the Rohini basin, some villages have access to numerous government organisations and other institutions such as banks and self-help groups (See figure 30). These organisations provided credit and other support for reconstruction following floods;
6. Good transport and communication systems enable people to commute longer distances in search of work and enable goods and services to flow easily into and out of areas.

As a result of these factors, few households in the Rohini had to sell gold ornaments or other assets and few children in the Rohini area are forced to withdraw from school and earn wages. This may be one reason why the

percentage of literacy is higher in the Rohini than in the Bagmati basin. Culture and tradition also seem to play a major role in the way people cope with flood disasters. In the Bagmati basin because of the *purdha* system few women go outside their homes and very few work as labourers. In contrast, women in the Rohini basin have some skills and venture abroad for jobs. Several women have even gone to the countries of the Middle East. Women in Rohini basin also control a higher share of assets and income. Women's economic activity has helped communities in Rohini basin to cope with flooding. Individual narratives showed that people in the Bagmati basin often preferred to sell land than to go to other places for work. This preference, which is heavily influenced by concerns about social status, led them to sell productive assets rather than diversify income sources. As a result, some families have become landless squatters (See box 7).

The diversified nature of income sources helps families cope with flood.

## BOX 7 From Riches to Rags

Rupi's father once owned 22 *bigha* of land in Rautahat. The family commanded respect and neighbours addressed his father as *mahajan*. Rupi's father was generous, too: he gave loans and fed the hungry and the poor of the village. He did not bother seeking a witness for loans or charge high interest rates on loans.

Rupi grew up in comfort and led a carefree life. He did not have to do any work as the *mazdoors* (labourers) employed by his father did all the manual work. His father neglected his education and instead lavished him with all the affection and luxury he could afford. Rupi's father also enjoyed drinking and gambling, a behaviour he thought was expected of the rich. Rupi looked at his father as his idol and developed similar tastes.

The family's assets slowly began to dwindle as people did not meet payment in their loan. Since there was no written proof of the transactions, the family had no legal redress either. Gradually the 'good old days' began to fade.

In 1954, a devastating flood in the Bagmati River washed away two *bigha* of land and the crops planted on it. The flood deposited sand on another five *bigha* of land. Four years later in, 1958, Rupi's father was forced to sell eight *bigha* of land to make ends meet.

Due to the devastation caused by the floods and un-recovered loans, Rupi's father fell mentally ill and died two years later. Shortly after that Rupi inherited the property. The financial state at home had taken a turn for the worse due to both recurrent floods and his extravagant habits. Due to the strict system of *purdah* practiced by the local community, Rupi's wife felt she could not leave their home to search for work. Now the father of a son and two daughters, Rupi found that his life had become more difficult. He had neither skill nor education and could only make a living by cultivating the land still untouched by floods.

A few years later he sold one *bigha* of land to raise money to marry both his daughters. After the Bagmati River flooded in 1988 life became even more difficult for Rupi. By 1993 flood had forced him to move his house four times. The last home was one kilometre away from the Bagmati. Each time he had to sell a little more land in order to build a new home. He was left with just a little over half a *bigha* of land. The monstrous flood of 1993 deposited sand on all his land.

On the disastrous night in July 1993, he was sleeping and woke up to hear screams 'Floods! floods!'. He did not take the cries seriously at first because floods are common in the area, but soon the rising water flooded his room. He ran to rescue his family. His son took his wife and mother to the *mukhiya*'s two-storey building, which was in a safe place. Rupi ran to a nearby *sisau* tree and climbed it up for safety. From the tree he watched his and others' home slowly wash away. The flood swept away his properties and assets.

The village remained under water for five days. Rupi's family stayed at the *mukhiya*'s house during that period but had no food. Slowly the water subsided and relief organisations arrived. They distributed beaten rice, sugar, biscuits, bread and noodles, but these supplies lasted for only a few days. A few days later Rupi and his family moved to Madhipur where one of his daughters lived.

Rupi and his family could not stay in his daughter's house for long because this is not socially accepted practice. After two months they came back to what remained of their home. Sand deposition had damaged their land so badly it grew nothing. They had lost their livelihood. A local merchant offered them a refuge in his cowshed for few days.

Later the Red Cross society, and Marwari Sewa Samiti distributed food, clothes, and utensils to flood victims. Rupi felt that the organisations were a godsend. He said that without their help his family would have gone hungry and probably would have died. He decided to send his son to Kathmandu to sell *kawad* (junk). His earnings would help the family survive.

Foreign help also helped to rehabilitate the flood victims in Paurahi VDC. A joint effort by the Nepali and Taiwanese governments made new homes to resettle flood-affected families. Rupi's family were given a unit and went to live there. Local residents, however, did not welcome newcomers; they said that they would not live with strangers. Within days Rupi and other flood-affected families had been chased out.

They lodged complaints at the District Development Office and Rehabilitation Organisation. One year later the organisation built new houses for Rupi and other displaced people. They have lived there ever since.

Rupi Sah has opened a shop to earn a living but still faces hardship. His daughter-in-law helps him as circumstances have forced her to abandon the practice of *purdah*. Along with her two school-going daughters, she travels to the Bagmati River to make aggregate by crushing stones.

## BOX 8 Resettled Communities

In both Bagmati and Rohini basins people have, in the recent past, been displaced from their homes by floods and landslides and forced to live in a different natural and social environment. We interviewed a total of 455 households which had been resettled. Of them 297 were in the Bagmati basin and 158 in Rohini. About 44% of the resettled households are female-headed whereas in permanently established villages only 37% were female-headed. The following table shows the years in which various new settlements were established in the two basins.

### Year of Settlement

River Basin	Number of Households with year of Settlement				Total
	2-5 years	5-10 years	10-20 years	> 20 Years	
Bagmati		297			297
Rohini	16	11	5	126	158
Both	16	308	5	126	455
%	3.5	67.7	1.1	27.7	100

In the Bagmati, most of the people came from neighboring VDCs whereas in Rohini hills people are among the migrants. As a result the ethnic composition in Rohini is mixed. In the Bagmati basin 49% households are of Tarai origin where as in the Rohini basin 65% are of hill origin. Floods in their village of origin had displaced the new settlers in the Bagmati basin, but migrants to the Rohini had moved for more than one reason. Some had come seeking better livelihoods. A few in each place had migrated because they had been made landless by floods, landslides and debts.

About 68% of the total resettled population had moved within the last 5-10 years. In the Bagmati all of the people interviewed had settled in the last 5-10 years. In Rohini people came earlier. Some of them were there for more than 20 years. Only 3.5 per cent of the total interviewed households migrants had settled within last 5 years.

In established villages only one house in the Bagmati and 15% in Rohini had *pakka* roofs. In resettled areas in Bagmati, in contrast, 52% houses had *pakka* roofs. Many of them own land outside their village: this land serves as a source of livelihood. About seven per cent of the total resettled population still farm, while almost 42% earn their livelihood by doing labour work. In Bagmati this figure is much higher (see Table). Floods alter the livelihood of a community, as the following table clearly shows.

### Occupation of the Sample Population of Resettled People

River Basin	Number of Households by Occupation Type					Total
	Farmer	Labour	Service	Business	Others	
Bagmati	8.3	56.1	2.8	8.5	24.3	100
Rohini	4.1	21.2	7.6	0.8	66.3	100
Both	6.6	42.1	4.7	5.4	41.2	100

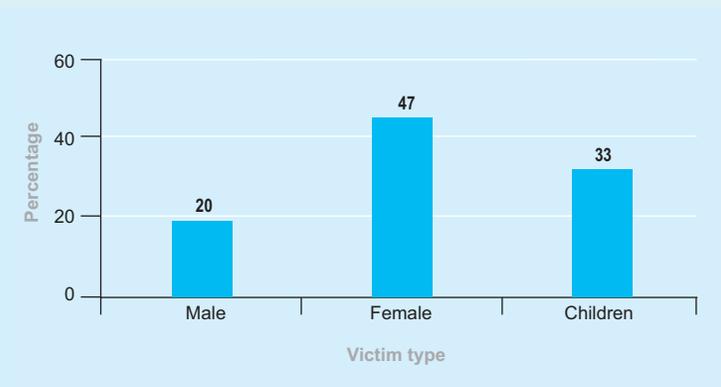
Only 6.6 per cent of the migrants households were engaged in agriculture, far fewer than the 36% of normal respondents who farm. The contribution of income from labour to the total household income was 16% to 42% for migrants. A majority of the resettled relied on wage labour for survival.

Each displaced family lost assets when it moved; on the average their worth was NRs 84,000. Sixty-five per cent of the respondents lost land while fewer lost houses (14.8%), crops (8.6%), livestock (7.4%), and other assets (4.7%). With the loss of land people lose the hopes of being able to survive in their native home and are forced to become squatters elsewhere. In Bagmati, where all the resettled households had been displaced by flooding, the loss was almost two times (an average of NRs 100,167/hh) than that in Rohini (NRs 55,242/hh). In other areas, the average reported loss was about NRs 30,172 per household. Animal husbandry is still as important for forced migrants as well as for other communities.

Families often opt for cottage industry when floods ruin livelihoods in agriculture. In general, industry contributes only one per cent of total income of the families living in original homes. For families which have moved to new areas, cottage industry accounts for about 8.6 per cent of total income. New skills and opportunities can provide better alternatives to those who have to adapt to post flood situation.

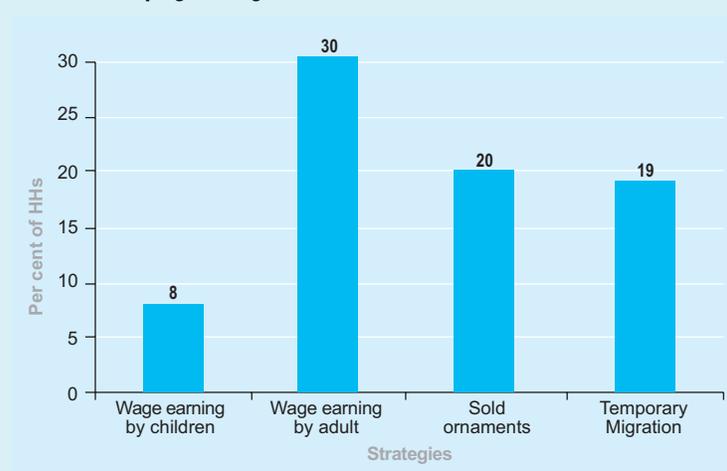
When land was lost the share of income from crop farming dropped from 22% to 15%. Agriculture became a secondary occupation due to the lack of land. The share of income from trade and business, which was just four per cent among ordinary households increased to 20% among resettled families. The share of livestock rearing income was about the same in both cases. There was not much difference between the native villagers and the migrants regarding perceptions of flooding. Women and children suffer more than adult males.

**Flood Affected Families**



The coping strategies of migrants is different from those of people living in their native villages. Because they have already suffered, they seem to be better prepared. Losing agricultural opportunities has forced them to have more than one income source. In established villages only three households out of 960 sold land and about 4.3 per cent or 43 houses sold ornaments as a coping strategy for survival. About 3.7 per cent of households sent their children out to earn a wage. Many people (77%) performed wage labour and about the same percentage migrated temporarily. In case of resettled villagers, only about 30% of the adults made living as wage workers and 8% of households sent their children for work. About, 20% of the households sold ornaments more than established villages.

**Post Flood Coping Strategies**



## INDIA: Bagmati, Rohini and Rapti

The situation in India along the lower portions of the Bagmati and Rohini rivers differs substantially from that in Nepal but also has many parallels. The Bagmati River flows from the locations studied in Nepal into Bihar, one of India’s most backward states. The Rohini flows to Gorakhpur in eastern Uttar Pradesh, which while far from being a wealthy area, is characterised by much more economic diversification than the Bagmati basin. As a result, many of the economic conditions found upstream in Nepal are replicated on the Indian side of the border. This said, the length of the rivers within the low-gradient larger Gangetic basin is far greater in India than in Nepal. The characteristics of flooding are, as a result, very different. In addition, the political context is different. These aspects are explored in detail in the case studies below.

### Methodology

To carry out the field study a series of villages were selected in the Indian portions of the Rohini and Bagmati river basins (See table 32). The methodology adopted for selection of the villages was as follows:

- Sample villages located in the two basins were selected after visiting the area and consulting the local district administration responsible for flood mitigation in the concerned areas;
- Eighteen villages were selected from six development blocks representing four districts of two states;
- Villages selected had to meet these criteria:
  - Exhibit location specific conditions of *kacchar*<sup>8</sup> and *doab*;<sup>9</sup>
  - Contain villages situated inside and outside embankments;
  - Contain a variety of castes and socio-economic groups.
- Within each village a sample survey covering more than 30% of the population was administered;
- A total of 1,768 HHs households were interviewed using detailed structured questionnaires in order to collect information about flooding, livelihoods, rural infrastructure, and trends in migration;
- Household interviews were supplemented with a series of focus group discussions. These included:
  - General group discussions of flood impacts on all communities of the village;
  - Focus group discussions exclusively with women to gather gender specific information on their experiences in before, during and after floods;

**The nature of flood in the Nepal Tarai, Bihar and Uttar Pradesh differs in character.**

Table 32: Study Sites in Uttar Pradesh and Bihar

Basin	State	District
Rohini	Uttar Pradesh	Gorakhpur
		Deoria
Bagmati	Bihar	Darbhangha
		Sheohar

**Gorakhpur and Deoria are among the most flood-affected areas of India.**

- Interviews with key informants like community leaders, local village *panchayat*<sup>10</sup> functionaries, members of self-help groups (SHGs) and other community-based organisations (CBOs), untrained traditional birth attendants, local religious leaders, teachers and others.

■ In addition to surveys and focus group discussions, a variety of PRA techniques were used in each location. They included:

- Social mapping
- Resource mapping
- Service mappings
- Wealth ranking
- Time line
- Ethno-histories of flooding
- Venn diagrams
- Seasonal diagrams

### Basic Profile of the Areas

**Eastern Uttar Pradesh:** Eastern Uttar Pradesh embraces an area of 33,270 km<sup>2</sup> and forms 11.28% of the geographical area of the state. Spread over many districts including the case study sites (Gorakhpur and Deoria), the region is commonly known as the trans-Saryu plain and is situated to the north of the middle of the Ganga River. Depending on the gradient, which averages 20 cm/km, the region is divided into three distinct parts known as the *Tarai*, the *Khadar* and the *Bangar*. Locations of the case study districts are shown in the accompanying map of Uttar Pradesh (See figures in pages 118 and 119).

**Bihar:** After Jharkhand became a state, Bihar, which was already one of the most flood-prone areas of the country, became a state where floods are endemic. The state is dominantly rural. Out of 94,163.00 km<sup>2</sup>, the rural areas constitute 92,257.51 km<sup>2</sup> and urban areas only 1,095.49 km<sup>2</sup>. The average height of the state is 52 m above sea level rendering it most of it highly vulnerable to flooding.

According to the 2001 Census of India, the total population of Bihar is 82,878,796. Slightly over 60% of males are literate and just 33.57% of females. The population growth rate from 1991 to 2001 for the state as a whole was 28.43%. Population density per square kilometre is 880 and the region is crossed by many major and minor rivers. The locations of the case study districts, Darbhanga and Sheohar, are shown on the accompanying map of Bihar (See pages 118 and 119).

### The Study Sites

In Bihar, and Uttar Pradesh the districts chosen have low gradients and flooding is common. These districts are, in fact, among the most flood-affected areas of the country. The devastating impact of floods on the socio-economic development, education and rural infrastructure of the region is clearly visible. Abject poverty, poor health services, malnutrition, illiteracy, lack of food security and livelihood, extensive out-migration, and ecological degradation are characteristics common to all four areas of study.

**Deoria and Gorakhpur districts:** Deoria and Gorakhpur districts are on the eastern border of Uttar Pradesh. Gorakhpur contains the main regional center for which the district is named. Deoria's headquarter is situated 53 kilometres east of the city of Gorakhpur by road. The Ghaghara, Rapti and Chhoti Gandak are the main rivers in this district. In addition to these, the many small rivers flowing through the area constitute part of the drainage systems. The average rainfall in both districts is between 800 and 900 mm per year. The maximum precipitation generally occurs in July and the minimum, which is zero, occurs in December and March.

The population density (population per sq. km.) of Deoria and Gorakhpur districts is in the high 800s. Nearly 15% of the population are Scheduled Castes, but only 0.01% are Scheduled Tribes. Ninety per cent of the people live in rural areas. Both districts contain approximately 2000 populated villages.

Agriculture is the main occupation of the people of Deoria and Gorakhpur. The districts have fertile land and slopes towards the southeast. The soil in northern area is mainly bhat type, that in the middle region is mainly domat (silty) type and in south region the soil is mainly balui domat (sandy silt). The middle portion of the districts is fertile. *Rabi* crop consists mainly of wheat, millets, gram and mustard (*lahi*). *Kharif* crop consists mainly of rice, maize, and arhar. Sugarcane is widely cultivated as a cash crop. Due to poverty, child and early marriages are common in both districts. The villages selected for this

study are located between the Rohini and Rapti river basins. Their locations are indicated in Table 33.

**Darbhanga and Sheohar:** According to 1991 Census of India, Darbhanga District has a total geographical area of 2,279 km<sup>2</sup> and population of 2,507,815. The district is bounded on the north by Madhubani District, on the south by Samastipur District, on the east by Saharsa District and on the west by Sitamarhi and Muzaffarpur districts.

Sheohar is a new district carved out from Sitamarhi District. The total population of Sheohar is 3,77,699, the rural population is 363,784 and the urban is 13,915. The total population of Scheduled Castes is 54,476, 52,521 in rural areas and 1,955 in urban areas. There are four developmental blocks in the district: Sheohar, Tariyani, Piprahi and Dumrikatsari.

In both Darbhanga and Sheohar districts over 80% of the total area is cultivable. The soil is highly calcareous and clayey-sandy in texture, which make it suitable for rice and *rabi*, crops. Paddy is the main crop but wheat, maize, pulses, oil seeds, sugarcane and *maruwa* (*dwarf millets*) are also grown. The average land holding size in both districts is approximately 0.6 hectares and per capita food grain production is about 65 kg per year. The districts are full of mango orchards. Other trees crops include *sisoo*, *khair*, *palm*, *khajur*, *jackfruit*, *litchi*, *pipal*, *jamun* and guava. These trees are generally found

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**The devastating impact of floods on the socio-economic development, education and rural infrastructure of the region is clearly visible.**

near human settlements. Many ponds are present and both districts have some tracts of grasslands.

The regional literacy rate is approximately 29% which is much below the national average of 52.21% and the state average of 38.48%. The male literacy rate is 48% and the female literacy rate is 16%. The infant mortality rate is 115/1000 live births and life expectancy at birth 47.6 years. There are altogether 37 wards and one municipal corporation in both districts. Due to poverty, child and early marriage is common in both districts.

The main river systems in the districts are the Bagmati, little Bagmati, Kamla and Tiljuga. The Bagmati River, which enters these districts from Muzaffarpur, forms a natural boundary between them and Samastipur District and flows along a southeasterly course till it empties itself into the Burhi Gandak River near Rosera. The little Bagmati enters the district from Madhubani near Pali and turns past the town of Darbhanga down to Hayaghat, where

the Bagmati proper joins it. The Kamla River enters Darbhanga District at Singar Pandaul, and flowing east joins the Tiljuga in the southeastern corner of Rosera Development Block. The names of the villages surveyed in Sheohar and Darbhanga districts are listed in Table 34.

**Differences between sites in Bihar and Uttar Pradesh:** Substantial differences exist between the study locations in Bihar and those in Uttar Pradesh. In Bihar, due to changes in the course of the Bagmati River, many rural people have left their villages and are living on embankments. In Belwa village, for example, nearly half of the land has disappeared due to river bank cutting and many people have been displaced. In UP, however, people leave their villages only in emergencies and then return after floodwaters recede. This situation parallels that in upstream along the Rohini and Bagmati in Nepal: people in the Bagmati basin move permanently, while most displacement along the Rohini is temporary.

Though endowed naturally with fertile plains, Bihar has endemic poverty.

Table 33: Rohini and Rapti River Basin Villages

River basin	State	District	Development Block	Village	Other rivers/ Water bodies of village
Rohini	Uttar Pradesh	Gorakhpur	Campierganj	Chandipur	Bhadi Tal
				Sona Teekar	Giddha Tal and Majhaua Tal
				Fatthapur	Bhadi Tal and Kanari Tal
Rapti	Uttar Pradesh	Gorakhpur	Brahmpur	Singhorwa	
				Chithari	
				Ranapar	Gorra River
		Deoria	Rudrapur	Gaighat	Bathuwa Nala
				Sonbah Mustakil	Bathuwa Nala and Gorra rivers
				Kodari	Gorra River

In both Bihar and UP, the migrants return before flood season to look after their houses and families. But in Bihar people return before floods because their huts can be easily destroyed and many people do not have permanent base. They attempt to salvage their assets and look after their family members. Landlessness contributes to out-migration from Bihar and to a variety of other indicators of poverty. Begging, for example, was frequently given as an occupation during our surveys of Bihar but it was not prevalent in UP. In addition, the majority of the population living in Bihar villages were women, elderly people and children; most men had migrated to other places for work.

Most villages in UP were first inhabited 400-500 years ago while in Bihar settlement is much more recent, because the rivers shift. The *zamindar* system, which was abolished in the early 1950s, used to be common in both areas. In UP the elevations of villages were increased as part of a government programme which started

in 1957 and continued intermittently until 1985. Almost all villagers in the study identified this scheme as part of the government’s flood control programme, but no one in Bihar spoke of it. India Mark-II hand pumps began to appear in the region in the early 1980s and installation extended out over much of the 1980s and 1990s. The first private boring in the case study areas in UP was completed in 1972 and the first tubewell was installed in 1985. Electricity came to most villages in the 1980s. In Bihar, the process of electrification has been slower. In Singahi, for example, electric poles were installed in 1977 but actual electrification was still taking place as we conducted our survey. The village was finally electrified in 2003.

Telephone connections have been extended into many rural areas. In UP, the first WLL Telephone was installed in 2001, while in Singahi, Bihar, public telephone connections were provided to the village in 1996.

The above patterns, which vary from village to village, illustrate that while

**The catchment of rivers in Bihar also lies in Nepal.**

Table 34: **Bagmati River Basin Villages**

River basin	State	District	Development Block	Village	Other rivers/ water bodies of village
Bagmati	Bihar	Sheohar	Piprahi	Belwa khurd	Lal Bakaiya
				Inrwa khas	
				Singahi	
		Darbhanga	Hayaghat	Naya tola	Adhwara Samuh, Kareh River
				Akraha	Kareh River
				Dusadh tola	Nasohar nala
			Hanuman Nagar	Phulwaria	Ekmi, Adhwara Samuh
				Uchauli	
				Bhawaniapur	2 big ponds

progress in development has been gradual and incomplete in both regions, in Bihar it has been far slower.

### Flood Frequency and Ethno-history of Flooding

**Rohini and Rapti:** An ethno-history of flooding along the Rohini in UP is outlined in the table 35. It documents the varied nature of flood events and their social impacts. Major flood events occurred in 1904, each year from 1952 to 1957, 1962, 1968, 1970, 1971, 1974, 1980, 1981, 1998, 2000 and 2001. The latest flood of 2001 was followed by a drought in 2002. Attempts were made to control flooding along the Rohini and Rapti rivers by constructing embankments, a process which began in 1952 and continued intermittently until 1985.

It is impossible to provide details on the impacts of flooding in all case study villages, but the case of Gaighat illustrates the situation well. Gaighat is situated on the bank of the Rapti River between this river and the Bathuanala. It has been affected by flooding and land cutting for as long as the villagers can remember. In most years, flooding has occurred for a brief period and hasn't had a major impact on life. During the period from 1952 to 1957, however, parts of the village were cut down by the shifting course of the Rapti and villagers were forced to settle elsewhere or to build new houses in agricultural fields. This history repeated between 1960 and 1980, when the shifting course of the river destroyed more land and houses. As a result, approximately half of the

villagers have migrated to safe places. The remaining villagers have moved their dwellings into agricultural fields. As a result of the regular disruption and shifting, Gaighat has been sub-divided into three smaller villages-Gaighat, Rampur and Sonbha Ehtemali.

In the late 1980s an embankment was constructed to check the problem of flooding and much of Gaighat was indeed protected from annual floods to some extent. Many houses, however, were located beyond the embankment and most of these collapsed one after another as the river encroached upon them. In 1998 the embankment breached and the village experienced the worst flood in its history. The initial breach occurred in the adjacent village of Malpurwa and after that dozens more occurred. The resultant flash flood destroyed many structures and the water also remained in the area for a long period afterwards. There was dangerous flooding again in 2001 but not on the scale of 1998.

The history of Gaighat is typical of the history of many villages between the Rapti and Rohini. The gradual movement of the river often affects those located on the banks of large rivers. They are also flooded on an annual or, in any case, frequent basis. Except during extreme years most of these floods are manageable. When embankments are constructed the situation changes: regular flooding is reduced for villages inside the embankments but the impact of large floods is increased by embankment breaches.

While progress in development has been gradual and incomplete in both regions, in Bihar it has been far slower.

Table 35: Ethno-history of Floods in Rohini Basin

Year	Event
<b>Chandipur:</b>	<b>Flood:</b> 1962, 1972, 1984, 1991, 1998, 2001 and 2002
1962	Flooding caused by heavy rainfall led to loss of property and lives. Villagers took shelter in neighboring Mahuwari forest and Aligarh village three kilometres away.
<b>Sonateekar:</b>	<b>Flood:</b> 1962, 1971, 1980-81, 1986, 1998 and 2001
1962	Flood affected agricultural fields and houses. Sonateeker, Baggha, eastern Gulahriya and Rehar were inundated.
1981	A junior engineer fell in the floodwater. Villagers saved him. Later he lodged an FIR against them. Many villagers were arrested. The matter was settled through compromise, but the villagers see this as the main reason for the neglect of their village by officials.
<b>Fattepur:</b>	<b>Flood:</b> 1962, 1964, 1976-78, 1984, 1998, 2000 and 2001
1984	Embankments breached at more than a dozen places and the entire village was inundated. Villagers took shelter in Mahuari forest for about three months. Government did not provide support.
<b>Singhorwa:</b>	<b>Flood:</b> 1957, 1962, 1974 and 1998
1962	Floods in the Rapti River marooned the entire village. Crops and houses were ruined and livestock were swept away. According to villagers, the government has raised height of the village in the past but the village is still affected.
<b>Chittahri:</b>	<b>Flood events:</b> 1904,1952,1962-63,1964,1974,1980,1990,1998,1999,2000 and 2001
1990	The village was inundated. The river flowed through the village and it vanished. Collector of the area suggested that the villagers migrate to some safer place and leave this flood-prone area. No relief was distributed.
<b>Ranapar:</b>	<b>Flood events:</b> 1957, 1998
1957	Village height was raised under a government scheme.
1998	Embankment damaged near Tighara. Vishunpura, Silhat, Dieva and Ranapar villages were also affected. Sand casting occurred in some fields to a depth of 10 feet. Around 225 animals were swept away. Five elderly persons died due to the lack of food and treatment. Due to lack of timber dead bodies could not be cremated and were thrown in floodwater.
2002	Drought
<b>Gaighat:</b>	<b>Flood events:</b> 1952-57,1960-80,1985,1997 and 2001
1952-57	The river eroded the village and the inhabitants resettled on adjacent land.
1960	Bank cutting destroyed much of the village
1980	Bank cutting destroyed much of the village
1998	<ul style="list-style-type: none"> <li>The flood of 1998 was the most damaging in last 100 years. Many <i>kachha</i> houses and huts were destroyed and some <i>pakka</i> houses developed cracks. Agricultural fields were totally destroyed. Luckily, no human lives were lost. People took shelter in Mahuwari forest. The flood affected all villages.</li> <li>This flood was a nightmare for people of Fattepur. Due to the heavy downpour, water levels entered houses. People stayed at shelters for about three months. Many houses, huts and agriculture fields were destroyed. Government distributed relief of Rs 1000/- per household along with some food, and kerosene.</li> </ul>
<b>Sonbah Mustakil:</b>	<b>Flood events:</b> 1950,1962,1962-74,1980-82, 1998 and 2001
2001	Flood destroyed embankment at Shital Majha. As a result, water entered in the village and destroyed everything. The flood drained by breaching the embankment on the south side of the village. <i>Kachha</i> houses and huts were destroyed completely. Stored grain, fodder and fuel were rotted. Waterlogging lasted for around a month.
<b>Kodri:</b>	<b>Flood events:</b> 1965-70, 1983, 1985, 1998, 2001 and 2002
2001	An embankment breached near the village of Hosh. Water remained for about 40-60 days.
<b>All villages were flooded in 1998</b>	

**Bagmati:** Major flood events occurred along the Bagmati in 1825, 1905, 1942, 1953, 1954, 1962, 1966, 1968, 1971, 1974, 1975, 1976, 1977-1983, 1986, 1987, 1988- 1989, 1990, 1992, 1993, 1994, 1995, 1998, 1999, 2000, 2001, 2002 and 2003 (Table 36). The frequency and intensity of floods is higher in the Bagmati than the Rohini because the Bagmati is bigger. In addition to floods, droughts have occurred too, which have had a major impact on the livelihoods of villagers.

Majority (71%) believed that water released from dams and barrages in Nepal cause flooding. Construction and failure of embankments was mentioned as the next reason. Water contributed by various water bodies was mentioned as the reason for flooding by others.

### Impacts of Flooding

The impacts of floods in UP and Bihar are devastating. Recurring flooding has destroyed the livelihoods of many poor and vulnerable communities. Health and sanitation suffer, educational institutions are forced to close and employment opportunities dry up. Transportation is rendered difficult and local populations face major problems accessing markets and key services. In some cases, where bank cutting or sand casting occurs, the land is destroyed and owners lose their main productive asset. As a result, those who are able migrate to other areas. The impacts of flooding on women are particularly severe. These aspects are discussed in detail below:

**Livelihood system:** In most of the case study villages, vulnerable communities usually reside in *kachha* houses made of mud and other locally available materials. These are regularly destroyed by floods (Table 37). Each time a house is destroyed other critical assets such as stored food and household goods are lost as well. Losses are great because people have no place to move their things to, even when materials are portable and the flood arrives gradually. Saving bulky materials such as food and fodder is particularly problematic for the poor. Many of the wealthy are, however, able to move their goods onto the roof of their *pakka* brick and cement houses. After the poor lose everything to floods, they are forced to take loans to meet their consumption needs. Since local moneylenders charge interest rates as high as 120% per annum and daily wages are the main source of income for the poor, they never accumulate the money they need to build a *pakka* house of cement and bricks. As a result, each time floods occur they lose their assets again. Furthermore, if they are dependent on earning a daily wage they often cannot devote enough time to growing crops on the land they own. Thus, they end up depending on the market to meet even their basic food needs. Since food is expensive, food insecurity is high.

Despite their clear impacts, not all aspects of flood are negative. Some of the villagers interviewed mentioned, for example that flooding helped cultivation of banana, increased soil fertility and helped fisheries. They also suggested that the impact of floods could be minimised through:

In most of the case study villages, vulnerable communities reside in *kachha* houses made of mud and other locally available materials. These are regularly destroyed by floods. Each time a house is destroyed other critical assets such as stored food and household goods are lost as well.

Table 36: Ethno-history of Floods in Bagmati Basin

Year	Event
<b>FLOOD</b>	
<b>Bhawanipur Deeh:</b> 1984, 1987, 1998-99, 2000 and 2002	
1987	Floods washed 25 houses away. People took shelter on roofs. A baby was born on a thatched roof while other was born on a boat when village was being evacuated. Affected people took shelter on Deeh (place where idol of God or deity installed for worship).
2000	Villagers took shelter on bund. During evacuation, a boat turned over killing all but one 10 year old child. He managed to get hold on the back of the boat and was rescued later. He helped our survey team in reaching flood-affected villages in his boat.
<b>Dusadh Tola:</b> 1904, 1936, 1942, 1954, 1974-1975, 1976, 1987, 1988-1992, 1994- 1998, 2000 and 2001	
1987	Devastating flood damaged railway line suspending train services for over three months. Houses were washed away.
2001	Embankment breach near Pachphutiya. Railway line was damaged for three months. Because of the embankment breach, flood waters receded rapidly and losses were relatively low.
<b>Naya tola:</b> 1905, 1942, 1954, 1962, 1976, 1978,, 1987, 1989-1992-1996, 1999-2003	
2002	Bund, railway bridge and railway lines were damaged. People took shelter on thatched rooftops.
<b>Akraha:</b> 1952, 1962,1966, 1974, 1977-1986, 1987, 1988-1992, 1993, 1994-1998, 1999, 2000, 2001, 2003 and 2004	
1987	Flood broke all the previous records. The railway line was damaged. Villagers took shelter on embankments. The village was inundated for a long time. All the houses were damaged.
<b>Singahi:</b> 1825, 1954, 1965, 1971, 1974, 1975, 1983, 1987, 1988,1990, 1993, 1994-1995, 1998, 1999, 2000 and 2001	
1983	Heavy flooding eroded two kilometres of the embankment. Floodwaters entered the village. Bagmati flowed into an older channel. Agricultural fields were totally destroyed.
<b>Indarwa:</b> 1974, 1975, 1985, 1988, 1993, 1998 and 2002	
1985	Floods submerged the village and 7 men, 21 goats and 3 cows died.
1993	Sand casting.
<b>Belwa:</b> 1954, 1974-1975, 1983, 1987, 1993, 1998, 2002 and 2003	
1993	Sand casting.
1987	Village school collapsed
1998	The flood of 1998 was most damaging in last 100 years. Many households were damaged. Cracks developed in <i>pakka</i> houses. The flood destroyed agricultural field but no human lives were lost. People took shelter in Mahuwari forest range.
<b>Phulwaria:</b> 1962, 1972-1986, 1993, 1008 and 2002	
1987	Flood broke all previous records. Water level increased at a rate of three feet per hour. People abandoned village while some took shelter on rooftops. In the village, 20-22 houses collapsed.
<b>Uchauli:</b> 1968, 1974, 1977-1986, 1987, 1993, 1994-1997, 1998 and 2000	
1998	Two children died due to snakebite. One person died because there were no boats and he could not be taken to hospital.
<b>DROUGHT</b>	
1944	Drought in Singahi. Lack of food forced villagers to mix powder of mango tree's bark with jawar-bajra's flour (millets) to make Roti (bread). People ate interior part of banana stem.
1957	Drought in Phulwaria, Naya tola and Dusadh tola. <i>Rabi</i> crop was ruined due to lack of water. People went hungry for many days. They ate buds and soft part of banana stem. They mixed dust of mango tree's bark with wheat flour to make bread

- Job opportunities in village as alternative to agriculture;
- Rehabilitation at place not affected by flood;
- Installation of drainage pumps for removing flood water;
- Timely repairs of bunds;
- Raising heights of bunds;
- Construction of *pakka* houses;
- Decommissioning of bunds that have build on only one side of a river or, alternatively, constructing bunds on both sides the same river;
- Reopening closed mouth of rivers and removal of sand deposits from fields.

**Poor health is a major problem in all flood-affected study sites.**

The level of vulnerability is clearly indicated by the nature of houses in the villages surveyed. Despite the wide variety of house types, only 28% are solidly built *pakka* houses. In the Bagmati *pakka* houses constitute less than 11% of the total. Men own virtually all houses in these basins. House ownership by women is limited because they have no decision-making authority regarding the selling and buying of property.

In areas along the Bagmati and Rohini where flooding is common, little

employment is available locally and most of those who are able, particularly the men, migrate.

**Health and Sanitation:** Poor health is a major problem in all flood-affected study sites. Water-borne diseases such as cholera, typhoid, dysentery and other gastrointestinal disorders are common, particularly during floods. Water related diseases such as malaria and Japanese encephalitis are also common as are non-water related illnesses. Anemia and malnutrition are frequent particularly among women and children.

The presence of many disease vectors is compounded by the lack of an effective health care system. Due to the poverty and backwardness of the region, well-trained doctors are rare and government health services are unavailable or, because of their high cost, are inaccessible in most areas. People depend on local knowledge or poorly trained, ‘health workers’ to meet their medical needs.

Local populations attribute many of their health-related problems to the recurrence of floods. Flooding exacerbates poverty and renders local populations unable to attract the types of resources needed for regional development to occur. Social infrastructure such as a health care system has had no chance to develop.

**Drinking water:** The poor health system is compounded by the lack of clean drinking water, a major point of concern in all the villages surveyed.

Table 37: Housing Condition in Case Study Areas

Types of house	Bagmati	Rohini	Total
Thatched (mud and thatch)	872 (78.7)	374 (37.3)	1,246 (51.1)
Kachha (mud or unbaked brick and sloping tile roof)	114 (10.3)	163 (16.3)	277 (13.1)
Pakka (cement and brick)	122 (11.0)	465 (46.4)	587 (27.8)
<b>Ownership</b>			
Male	808 (91.6)	334 (93.6)	1,142 (92.2)
Female	24 (2.7)	9 (2.5)	33 (2.7)
Joint	50 (5.7)	14 (3.9)	64 (5.2)

Figures in parantheses represent percentage

This concern is heightened during floods. The situation in the Rohini is illustrative (Table 38). Our survey of nine villages indicated that a total of 78 public India Mark-II hand pumps serve about 15% to 20% of the population. A further 40%, most of whom are well off, have installed private pumps drilled to the depth of 30 to 50 feet. The remaining population obtains water from surface sources. Even where they have access to wells, the quality of the water in most is poor and many have dried up and are no longer functional. As a result, during floods women must spend a substantial amount of time collecting water. Furthermore, in Gorakhpur, even at 100 feet depth groundwater is of poor

quality. Many of the poor are forced to drink floodwater. The level of drinking water vulnerability is clearly indicated in the detailed village survey results summarised in table 38. In Bagmati area, the use of private hand pumps is comparatively low probably because people frequently shift places due to river cutting. They seem less inclined to invest their meager earning in immovable assets like a hand pump (Table 39).

**Impacts on women:** As noted above, flooding has led to a high level of male out-migration and left women with much of the responsibility for dealing with floods. Since exploring the impacts of floods on women provides

**Local populations attribute many of their health-related problems to the recurrence of floods.**

Table 38: Sources of Drinking Water in Rohini Basin

ROHINI			
Village	Drinking Water Source (Pumps)		
	India Mark II	Private	Remarks
Chandipur	9	More than 60% families have private hand pumps, which are generally drilled to a depth of about 40-60 feet	The available water is of poor quality and not at all drinkable. In short, the quantity and not the quality of water is a issue for them.
Sonateekar	6	45 (bore 36' to 50')	1 well (dry). Two or three families jointly use one hand pump. After the flood they got bleaching powder from Block for cleaning water.
Fattehpur	2	45 (30-50 feet)	Even in normal days private hand pump's water gets pale in colour and this changes after few hours. They did not get bleaching powder during or after flood period from the government officials
Singhorwa	17	215 (40-60 feet)	17 hand pumps were provided to the villages with a population of over 2,500.
Chitahari	13	90	During flood, most of the hand pumps were sunk in floodwater. People bring water by boat from the open (not inundated) hand pumps.
Ranapar	4 (more than 110 feet)	60	During flood, hand pumps not flooded are used for taking water.
Ghaighat	12 (100 feet)	28 (30-40 feet deep)	The quality of private small hand pumps is good.
Sonbah Mustakil	12	42 (40-50 feet deep)	Cost of 6 hand pumps were shared by individual persons. Except this individual families have also installed pumps. Quality of water is poor.
Kodari		72	Drinking water from hand pumps are polluted. Water is pale and smells bad. Water does not taste good. Only one India Mark-II hand pump does not sink during flood. It is the only source of drinking water during flood.

clear insights into the impacts of floods on the society as a whole, the remainder of our discussion focuses on women.

First, it is important to appreciate the context: In eastern UP and Bihar, women are frequently denied land rights and there are marked gender differentials in agricultural wages, the divisions of labour and in the valuation of women’s work. In addition, the low status of women, particularly the dalit, the tribals and the Muslims, is indicated by the sex ratio (959 women for 1,000 men, according to the census of 2001) and by the gender discrimination in access to education, health and nutrition, and marriage practices (high dowries and their limited control over their body)<sup>11</sup>

Cultural norms also limit women’s mobility and decision-making powers.

The cultural and social environment of eastern UP and Bihar denies weaker sections of society access to development and services. Illiteracy, poor health and lack of access to information, for example, have played significant roles in marginalising these communities and increasing their vulnerability. Dalits and women are the most discriminated against, and disaster situations, such as floods, increase their vulnerability and the risks to their livelihood. Already poverty stricken, loss of property and crops, lack of food during and after disasters, and difficulties in accessing health and other basic services further affect their situation. This can have a

**Flooding has led to a high level of male out-migration and left women with much of the responsibility for dealing with their impacts.**

Table 39: Sources of Drinking Water in Bagmati Basin

BAGMATI			
Village	Drinking Water Source		
	India Mark II pumps	Government installed pumps	Remarks
Phulwaria	2		One well is situated in the north of the village but it does not work.
Uchauli	India Mark II hand pumps are used for drinking water	Number not available	Government installed hand pumps on embankments and in higher locations. Villagers take water from these hand pumps and store in house. Stored water is used by up to 14 houses. These hand pumps are very useful during floods
Bhawanipur Deeh		1	Only one hand pump has been installed north of the village. It does not function.
Dushadh Tola	3		NGO installed a pump. Two hand pumps get inundated during flood.
Naya Tola		3	There are seven hand pumps for a population of 300 in the village..
Akaraaha		5	There are 8 hand pumps. During floods three are inundated.
Singhai		6	Used for drinking
Indrwa			All pumps are close to each other. People in other parts of the village have to walk long distances to fetch water. They bring water once a day and store it in their houses. No private hand pumps are present.
Belwa		4	All hand pumps are used for drinking water. They are situated in south of the village. There are private hand pumps in the village

direct impact on basic survival needs. In a society traditionally influenced by feudal structures based on caste, women in the villages around Gorakhpur and Bihar, for example, have restricted access to food (Table 40). Specific ways in which floods disproportionately affect women are discussed in detail below.

*Responsibilities vis-à-vis workload:*

Women have the dual responsibility of managing a household (cooking, washing, cleaning, child rearing, etc.) and working outside the home (working in the field or working for a wage). Figure 31 shows the variation in workloads for women before, during and following flood events.

From the data, it is evident that women's workload is higher during and after disasters than during normal periods. The workload analysis brings up certain salient points:

- During floods, it appears that the workload of women is low, but in reality the trauma and psychological pressure of living in a temporary shelter (on the roadside or on embankments), without adequate food or protection makes their life miserable. Caring for and feeding children and cattle is an enormous responsibility. With inundated homes and fields, obtaining dry fuel becomes a major problem and cooking is very time consuming. Finding and collecting fodder also becomes very difficult and the responsibility rests with the

women as the men go to nearby towns to look for work. Everyone's health suffers.

- During disaster situations, the productive role of women outside the home is totally disrupted as they are neither able to work in their fields nor have the time to work as wage labourers. They therefore neither have access to nor control over wages.
- During emergency and disaster situations, and during the periods following them, household chores and activities increase dramatically – house repairs, cleaning, drying and fixing belongings, collecting fuel wood and fodder, etc. Regular household activities must also continue.
- Post-disaster periods are the most difficult for women, with reclaiming fields for planting added to repair and maintenance activities as well as regular household chores. In such situations, they have no option but to sacrifice their sleep and time to rest.

*Access and control:* Women's access to and control over resources, responsibilities and services are important to consider when planning their participation in disaster mitigation and development. Table 39 presents the access to and control over such resources for both men and women during normal and disaster times:

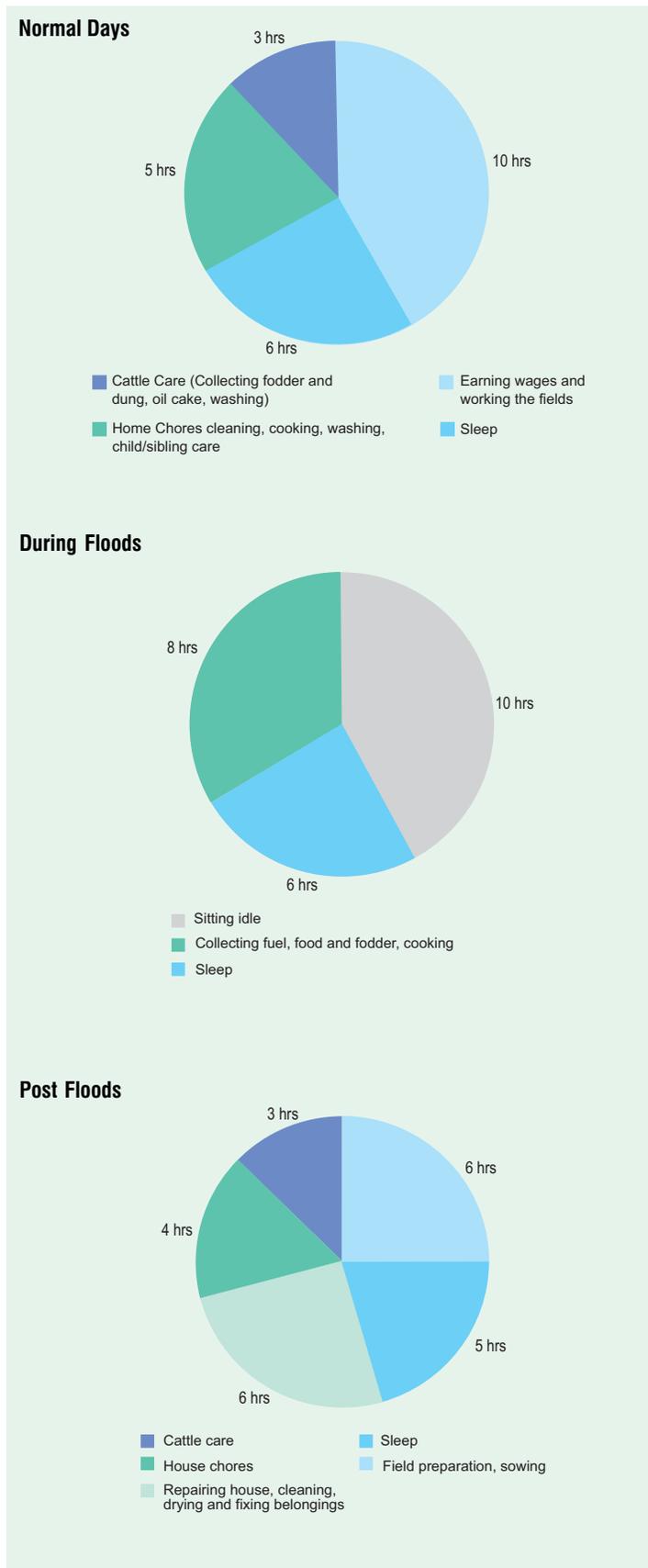
By analysing the situation, it becomes clear that, during times of disaster:

- Women lose control over those resources which normally are in

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**It is necessary to involve women in disaster planning and development and to ensure an effective communication and information system to help them address their situation, needs and priorities.**

Figure 31: Women’s Workload During Various Stages of Flood



their responsibility/domain: food, fodder, fuel and cattle rearing.

- The productive roles of both men and women are adversely affected. Women, however, completely lose opportunities to earn wages, largely due to their limited mobility and stereotyped roles.
- Women lose access to basic services such as health care and access to markets because of their lack of mobility and the unavailability of produces.
- In post-disaster recovery phases, households headed by women suffer the most. Having no control over productive assets such as land, which is never in their name, women face difficulties in obtaining loans. The recurring nature of floods in the region, with the consequent loss of assets, coupled with the total dependency on primary production activities for their livelihoods, out-migration of men is increasing. Women have no option but to manage their household in a situation where they have no control over productive assets.

Many common problems associated with flooding have a particular impact on women. The collapse of a house, for example, damages commodities and property, which are generally under women’s control. Thus recovery from a collapsed house creates increased pressure on women.

Defecation and the lack of private places is one of the biggest problems for women and creates a situation

where women sometimes have to wait for long periods before being able to relieve themselves. Self-imposed starvation to avoid having to defecate is a common occurrence in flood-affected areas. Personal hygiene becomes an acute problem, with genital problems increasing many-fold during floods. Skin diseases, respiratory problems, gastro-intestinal and disorders. are major problems.

Obtaining water that is safe to drink becomes a big problem and women have to manage with dirty, unhygienic water for their families. They are obliged to use floodwater for cooking.

Families who have their own land grow produce for sale and home consumption. Producing vegetables and fodder for sale and home use is generally in the woman's domain, and when crops are destroyed in floods, the women are deprived of direct access to these food sources and the earnings from crop sales. Women also work as agricultural labourers in the fields of others. As these get inundated, however, this wage earning possibility is taken away from them. The situation leaves women without any direct access to and control over income and key food sources. As women's earnings are generally spent on their own and their children's needs, such as food, toiletries, hygiene products and clothing, they and their children's are adversely affected by the loss of such income. The change in food consumption that results is shown in figure 32.

Table 40: Gender Differentials in Access and Control Over Resources

Resource	Normal Time		Flood Time	
	Access	Control	Access	Control
Food	F	F	F, M	M
Fodder	F	F	F	F, M
Fuel	F	F	F	M
Cattle rearing	F	F	F, M	M
Home care	F	F	F	F, M
Wages	F, M	F, M	M	M
Health services	F, M	M	M	M
Market	F, M	M	M	M

F= Female; M= Male

*Health issues:* Women eat very little even during normal times, approximately 1,000 calories a day, after the men and children have had their fill. This becomes acute during times of flood when there is very little food available, and women's daily caloric intake can go down to as little as 300 calories a day. In general, women get 15% of the available food, while the men of the family consume 50% and the children 35% (Table 32).

During the post-flood period, the situation does not improve significantly and women continue to consume as little as 500 calories a day, despite the greatly increased physical activities required of women after a flood.

In addition to the health impacts associated with food, other health problems are a major concern. Quacks and faith healers play a significant role in the community health care system, and in an area where babies delivered in institutions are still less than 20%, traditional birth attendants play a vital role. When serious

**The collapse of a house, for example, damages commodities and property, which are generally under women's control. Thus recovery from a collapsed house creates increased pressure on women.**

diseases or health problems strike, however, allopathic doctors are consulted at Primary Health Centers or private practitioners in towns and cities. In general, women are more easily able to consult local healers and traditional birth attendants and men are responsible for accessing the services of Primary Health Centers or private doctors if needed.

Women in this region suffer from various health problems even during normal times. They are more vulnerable to diseases and sickness due to their poor nutrition and consequently weaker bodies. During times of disaster, their problems become more severe. The major health problems, in order of importance, suffered by women during the flood and post-flood periods is shown in table 42.

Overall, diminishing resources and limited options during and after a disaster affect the women more than the men. It is clear that although the impacts of disasters affect everyone in

general, the extent of suffering varies according to gender, and that women are the worse off.

*Prioritising problems:* It is common, when attempting to identify the problems faced by a community, that the men only be consulted, and hence that solutions be male biased. This is true during times of disaster as well, and thus the problems, priorities and needs of women are neglected. As a result, it is necessary to involve women in disaster planning and development and to ensure an effective communication and information system to help them address their situation, needs and priorities.

During focused group discussions with women, problems related to floods, both during and after the disaster, that directly affect them were identified and can be prioritised as follows:

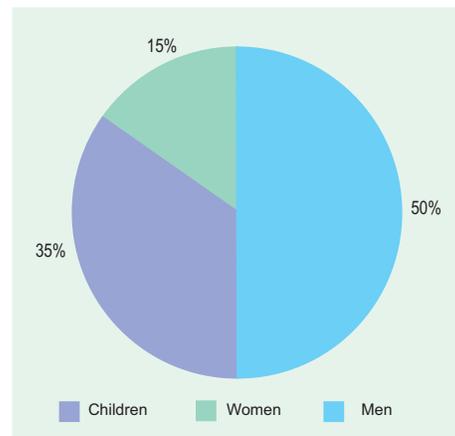
- First:** Loss of commodities and property due to collapsed homes  
Lack of sanitary facilities  
Lack of food
- Second:** Evacuation  
Lack of fuel
- Third:** Lack of drinking water  
Health and disease concerns (both for humans and cattle) Shelter

**Lack of access to services and transport:**

The above detailed discussion of the gender dimensions of flood impacts in the survey villages, in addition to outlining many of the root causes of vulnerability, also indicates the close link between overall levels of

**Women’s access to and control of resources, responsibilities and services are important to consider when planning their participation in disaster planning and development.**

**Figure 32: Percentage of Food Consumed by Various Members of a Household During Disasters**



development and flood impacts. Villagers surveyed in our study regularly raised issues related to lack of access to formal credit facilities, the absence of functioning institutions (banks, government departments, and schools), the lack of all weather roads and communications systems and, during flood periods, the lack of access to markets. All these aspects increase the impact of flooding and the difficulty of recovering from flood events. Most villages do have access to communications systems (radios and TVs are relatively common) but there is little information available relating to flood prospects that relates directly to their areas. The situation with regard to credit and institutions outlined in tables 43 and 44 for the Rohini case study site illustrates the situation well. The context of Bagmati Basin regarding these issues is even more dismal.

Overall, few institutions exist in the villages and those that do exist are weak. Critical services for flood recovery, such as access to credit are absent.

### Key Strategies for Adaptation

Because of the recurrent nature of floods in all case study areas, inhabitants have developed livelihood strategies that provide a degree of adaptation to regular inundation. Traditional practices for flood protection involved a combination of strategies including the selection of crops, particularly paddy varieties, that can tolerate flooding and the raising of village areas as points of refuge.

Table 41: Average Food Consumption per Woman per Day

Normal time	Disaster time	Post-disaster recovery time
Approx. 1,000 Calories	Approx. 300 Calories	Approx. 500 Calories
Chapati 175g or Boiled Rice 400g and Cooked Pulse 10g Cooked vegetable 150g Sugar 20g Oil 25g	Chapati 50g or Rice with Pulse 100g	Chapati 200 g or Boiled Rice 200 g and Sugar 20 g

Table 42: Health Problems Suffered by Women During and After Disaster

During	After
Skin Diseases	Cough, Cold
Flu, Cold, Cough	Fever, Malaria
Fever, Malaria	Diarrhea/Intestinal Problems
Body Aches	Reproductive Tract Infections
Respiratory Problems	Skin Diseases
Stomach Disorders	
Diarrhea	
Reproductive Tract Infections	

Following independence governmental initiatives have supported, in some cases, the traditional practice of raising village levels but have focused more heavily the construction of embankments. The presence of embankments has undermined the incentive to grow flood adapted varieties of paddy and has also, by blocking drainage, caused waterlogging and increased the duration when flooding occurs. Now most strategies focus on income diversification through migration coupled with relatively direct steps for protecting belongings, food grains, livestock and fodder. They also include mechanisms for ensuring drinking water availability, sanitation, dealing with health concerns, ensuring transport in flooded areas, and easing the collection and storage of fuel for cooking.

**Because of the recurrent nature of floods in all case study areas, inhabitants have developed livelihood strategies that provide a degree of adaptation to regular inundation.**

Table 43: Saving and Credit in Rohini Basin

Village	Saving and Credit
Chandipur	Nearest banks are at Compierganj (10 km) and Pipiganj (15 km). The Post Office in Bhanwrabari is also used for savings. People mostly rely on 'Tharia Baba,' a moneylender at Azamgarh District for loans. He charges exorbitant interest (120%) per annum. Every month, his men come to the village for providing loans and collecting interest. Villagers also take money from the rich men ( <i>Mahajan, Sahukar etc.</i> ) of the village or from their relatives.
Sonateekar	Post Office is situated in another village Sarar at five kilometres. The villagers use banks in Campierganj and Pipiganj. These banks are Gorakhpur regional bank, Union bank of India and State bank of India. Most take loans from local mahajan or sahuakar at interest rates of 40% per annum.
Fattehpur	Post Office is situated in Bhawrabari (three kilometres) and banks in Campierganj (10 km) and Pipeeganj (12 km). They usually take credit from the 'Tharia baba' at the rate of Rs 120/- interest per annum.
Singhorwa	Villagers borrow money from the rich men of the same village or the nearby villages for a variety of needs including festivals, marriages, medical emergencies, etc. They pay interest rates of five per cent per hundred rupees per month. They also borrow from the shops.
Chitahari	Generally they use the bank of Bhari and Kauri Ram. They also borrow from Sahuakar and the rich people of the village at the interest rate of 60% per annum. Generally they repay interest every month.
Ranapar	People take credit from the rich persons of the same village at interest rates of 24 to 60% per annum. This facility is always available. They also borrow money from their relatives but without interest. After flood people mortgage ornaments. Agricultural land does not remain as an asset. Due to sand-casting it loses its value.
Ghaighat	<i>Sahuakar</i> and rich persons of the village provide loans at an interest rate of 10% per month or 120% per annum. During floods, the rich also accept ornaments as mortgage. The poor borrow seeds and food grains from shopkeepers.
Sonbah Mustkil	The nearest bank is in Madanpur. Very few people have an account in the bank. They use the post office for saving and credit. For loans they usually go to sahuakar or the rich man of village of Madanpur. They get credit at the interest rate of 60% per annum. Sometime they get loan without any interest. People mentioned mortgaging their ornaments or selling their cattle during floods. General merchant shopkeepers also provide grain or other material on credit. Villagers return the money when they earn wages.
Kodari	Two banks of Pidra Ghat (three kilometres) and Rudrapur (1/2 km) are used by the villagers for saving and credit. They have to give 10% commission to the officers for taking loan or credit on farmer credit card. The Post Office is in Badha Village (1Km). It is also used for saving and credit. Local Sahuakar and Mahajans of Pachlari deeh also provide credit or debt at an interest rate of 60% per annum.

Table 44: Government and Non-government Organisations in Rohini and Rapti

Village	Government & NGOs
Chandipur	Panchayat Bhawan located in the village is used for meetings of governmental officials and other block level functionaries. Sometimes people also get involved in these meetings.
Sonateekar	There is one women's self help group. They use this to deposit fixed amounts and take internal or external loans for marriage, festivals, and to meet agricultural needs. No other organisation exists.
Fattehpur	Not a single government or non- government organisation works here. Villagers are ignorant about the schemes of Government and other support.
Singhorwa	No institutions
Chitahari	No institutions
Ranapar	There is one women's self help group formed by Sawarn Jayanti Swa Rozgar Yojna. The main purpose is saving and credit for general consumption. Jan Kalyan Sansthan an NGO is working in Ranapar. After the flood this organisation worked on land leveling, removing RANA (straw) and also initiated growing sugarcane on the sand laden area. Four borewells were also drilled.
Ghaighat	There are two self help groups (SHGs) operating in the village for savings and credit. People use these taking for consumption loans. The groups are not any income generating activity and are not recognised in the village.
Sonbah Mustkil	There are two self-help groups in the village. The male SHG is linked with a local bank while the female SHG is not. Female SHG collects money and uses this to provide loans to members. Neither SHG is involved in other activities.
Kodari	8-10 farmers are members of a cooperative society located in Pachlari Deeh. They take fertilizers and seeds from that society. It has not worked for at least 6 months (2003 march). They now depend on retail shops of Pachlari Deeh and Rudrapur.  There are three self-help groups of women. They do not work in community level preparedness or in any income generating work

**Migration:** Migration is the single most important strategy local communities in both Bihar and eastern UP have adopted for coping with floods. As agrarian communities, the basic source of income on which families traditionally depend is severely affected by recurrent inundation. The problems have been aggravated by sandcasting<sup>12</sup> in some villages along the Rohini and erosion of lands in Bagmati areas. As a result, our data indicate that between 60% and 80% of the male members of each village have migrated in search of work to nearby local towns and cities as well as to other states and foreign countries. Migration from our case study areas has occurred:

- At the very local level, to nearby towns and cities. Most of this is short-term and involves a search for daily labour.
- At the national level to locations such as Delhi, Punjab, Pune, Mumbai, Calcutta, Chennai, Bangalore, Surat and Hisar.
- Internationally, particularly to countries such as Dubai, Muscat, Bahrain, Saudi Arabia, Bangkok and Malaysia.

Most of those migrating do so to obtain access to labour markets as unskilled workers. Job opportunities that emerged regularly in our surveys included: labour in nearby brick kilns; rickshaw and *Thela* pulling; seasonal labour in agriculture fields in Punjab, Haryana, Delhi and Pune; selling fruits, vegetables and fruit juice in big cities; construction labour in different parts of India as well as abroad; furniture making; and work in jute, paper and

various factories as employee or as casual labours. Many migrants are also employed in skill-based jobs.

According to local respondents, income from outside work, whether local or via international migration, is essential in order to provide the cash or other assets that can be exchanged to meet basic food and other needs during floods and also as a source of assets for rebuilding when flood damage occurs.

**Protecting belongings and food grain from floods:** A wide variety of strategies have been developed for protecting belongings and other essential assets from flood damage. The single most important factor in the ability of families to protect their assets, however, is ownership of a '*pakka*' (cement and brick) house with a high flat roof. This roof provides a platform where assets of all types can be protected from floods. It is also a point of refuge that enables people to remain at their home location and protect assets from theft. According to the villagers, if they lack a solid roof one flood can set them back almost 20 years. Furthermore, before they can recover, another flood occurs bringing them into an even more vulnerable condition. As a result, they place a high priority on permanent structures. Even the poor generally attempt to build at least one solid room with a high flat roof. More well off people build two story houses or houses with partial double roofs. Public points of refuge, such as the roofs of school or other government buildings, are also important.

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**Migration is the single most important strategy local communities in both Bihar and eastern UP have adopted for coping with floods.**

In addition to the construction of brick masonry houses, other similar techniques for protecting assets were found including:

*Raising plinth height:* Under the government's policies the level of many villages has been raised more than once. More recently people themselves adopted these practices while constructing their houses by raising plinth levels of the houses to stay above the ever-increasing flood levels. The easiest way to do this is to build the new houses over the debris of the earlier houses. As a result, house levels have risen in parallel with flood levels over time.

Building *Machan* or *Macha* (structure of bamboo and hay): Making *machan* is very common practice in rural areas in general and flood-affected villages in particular. For making *machan*, four or six bamboo of equal size are fixed vertically inside the house. To make a platform, small pieces of bamboo are fixed horizontally at the top knotted with rope. The height is purposely kept over the last flood level. Bamboo can be replaced by wood. *Machans* are particularly useful for storing food grains, seeds and other food materials. Besides, other belongings like cloth, utensils, fuel, fodder and ration card etc are also placed on it. *Machan* can also be found in shelter places.

*Making plastic sheets:* Plastic bags of chemical fertilizers and seeds are easily available in rural areas. By cutting the edges from three sides these can be

unfolded and eight or more such pieces can be stitched to make a full-length plastic sheet. It is especially used for covering the belongings on *machan* in open place.

*Platform of Chawkis (wooden cots):* During inundation, people make a platform of wooden cots (*Chawkis*) putting one over other. This keeps the height of the cot above the water level and usually used for keeping belongings. These are also used for sitting, sleeping and cooking.

*Partial double roofing:* Partial double roofing (*Duchatti*) in *pakka* houses or building a thatched roof on the top of a *pakka* house are both common in rural areas. These sheltered points are used for storing cow dung cakes and other fuel materials. During flood, most of the belongings are shifted there. This is also used for cooking. When families move to safer locations, one person usually remains and looks after all the belongings stored in such locations.

Hanger for storing things in *pakka* house: Bicycle, cot, chair and other similar things are hung in *pakka* room with a help of rope and fixed nails. Small things like utensils, cloths, quilts, and blankets are packed in plastic bags and hung at heights above flood levels. This provides a degree of protection for short periods.

**Livestock and fodder:** Livestock rearing is one of the main sources of income in villages. In the case study villages, approximately 60% of the families have one or two animals. These provide both products for direct consumption and a

A wide variety of strategies have been developed for protecting belongings and other essential assets from flood damage.

critical source of income that is, to some degree, independent of other agricultural sources. As a result, livestock are a critical factor diversifying income and serving as an asset that can be sold in times of crisis.

Wherever possible livestock are saved during floods by moving them to high ground or other protected locations. Fodder is also secured where possible by storing it on the roofs of *pakka* houses or in trees.

#### Transport in flooded areas:

Transportation is a critical problem during floods. Boats are provided by the government through village *panchayats* but they generally arrive in the village very late after major devastation has already taken place. As a result, boats are essential but rarely available in sufficient numbers. For this reason, villagers occasionally cooperate to construct boats locally if they have sufficient advance warning of impending floods. They have also developed a variety of local techniques including:

- *Cot boats*: Cots are converted into boats for moving light materials such as fodder, fuel or food grains in limited quantities.
- *Karahi*: Large shaped *karahi* (pots used for making *Gur* out of Sugarcane juice) are used for mobility during inundation. This technique is commonly used in urban areas between narrow lanes where the flooding is calm.

- *Inner tube boats*: Tractor tubes are readily available in rural areas and are used to make rafts suitable for transport in relatively calm areas.
- *Pitcher boat*: Two large pitchers are tied together with the help of a bamboo and used as a flotation device in calm water. In normal times these pitcher boats are also used for collecting water chestnuts.

**Sanitation:** As previously discussed, defecation is a major problem during flood especially for women and adolescent girls. Villagers use two types of *machan* for this:

- *Fixed Machan* is used by women. It is attached at the edge of rooftop or the edge of settlement area of the village. For building *machan*, a bamboo platform is fixed over two or more bamboo tied with ropes. It is covered by straws and bamboo from three sides to ensure privacy.
- *Portable Machan* is used by men. It is built over the water apart from the house or settlement area of the village. It is made of three bamboo, altogether tied together into a tripod to provide a screened place.

Unfortunately, aside from privacy, neither type of *machan* provides much of any sanitation nor other benefits.

**Drinking water:** As the discussion above on sanitation suggests, pollution of drinking water sources is a major problem in the flood prone area. Shallow wells are contaminated, hand

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**Transportation is a critical problem during floods.**

pumps get submerged and the floodwater is highly polluted.

Both the quality and quantity of safe drinking water is a problem. Villages use their own knowledge for cleaning the floodwater to get potable drinking water. Another important technique is to raise the height of hand pumps. Some common practices for getting clean water are given below:

- *Boiled Water:* Use of boiled water is rare because of the scarcity of fuel.
- *Cleaning water with alum:* For cleaning 1 litre of water, 20-25 g alum is mixed with it. After 3 hours, the water is purified. All the contaminated waste rests in the bottom of the bucket.
- *Raising height of hand pumps:* The height of hand pump are raised by adding pipes in order to locate the outlet above flood level.
- *Installation of hand pump on shelter places or higher places:* Because villagers must move every year or alternate year to sheltered locations such as embankments and roadsides, wells are established in these locations to provide a secure, clean source of drinking water.

**Health:** Human and animal healths are heavily affected during flood periods. Because access to the formal medical system (where it exists) is both expensive and physically difficult in flooded areas, villagers depend heavily on the use of traditional

medicines. Key traditional medicines include *mehndi (Hena)* for infections and *neem* leaves for a variety of skin and stomach diseases and for washing wounds.

**Cooking:** Access to cooking facilities is often a critical problem in flood areas. In many cases, food is available but the lack of dry fuel and a place to cook make it unusable. To solve this, *machan*, plastered with mud to make a suitable cooking place are built on shelter places. *Chulas* (local mud stoves) are often constructed on this platform and on rooftops. Fuel is also stored in locations people have created above flood levels.

**Livelihoods:** During flood periods income from normal agricultural activities stops in rural areas. Activities that continue to provide income during flood periods include transport work and fishing:

- *Transport:* During floods, transport is a major issue and, for those who own boats, ferrying people and goods becomes an important source of income. During floods village boats are requisitioned by the revenue department and the boat owners are paid according to norms fixed by the government for assisting flood victims. In addition, to renting the boat, for each boat, one boat-man and two helpers are hired by government agencies. Private boats are also used in highly affected areas. Boatmen earn well but have to maintain boats throughout the year. As a

Income from outside work, whether local or via international migration, is essential in order to provide the cash or other assets that can be exchanged to meet basic food and other needs during floods and also as a source of assets for rebuilding when flood damage occurs.

result, the availability of boats often declines when areas have been protected from flooding for more than a few years.

- **Fishing:** Fishing is often a major source of food during flood periods. This is done using boats and nets or using fishing lines in agricultural fields. Fishing could potentially serve as a major source of income. At present, however, the income potential from this is limited.

Aside from the above two (relatively minor) sources of income, most income during flood periods is obtained from members of the family who have migrated and have work in other areas.

#### Checking erosion and river movement:

When a village or house is raised, the slope of the ground increases and it becomes more vulnerable to erosion. For preventing the erosion near by the houses, villagers set up bamboos, plants, creepers, twigs and bushes. They also construct (spurs) *thokar* into rivers to attempt to limit bank cutting.

#### Conclusions

Many of the above strategies for coping with floods may appear simple and, in relation to the impacts of flooding, at best partial. Both characterisations are on many levels accurate. This said, the strategies reflect key factors that are essential to recognise in their evaluation:

1. Migration and the construction of points of refuge enable people to diversify income sources and protect key assets. This allows

people to maintain and rebuild livelihoods rapidly following flooding events.

2. Most of the local strategies rely on resources that are in use during normal times and are therefore likely to be maintained and available, when needed. Key assets, such as boats, are maintained but where use is intermittent they are frequently unavailable.
3. Some key requirements, such as health, effective sanitation, access to drinking water and access to assured sources of dry fuel, remain major problems. Communication is also a major problem because rural telephone systems rarely function during flood periods.
4. Finally, the array of strategies indicates that the populations affected by flooding are not passive 'victims' but actively strategise and attempt to identify ways to mitigate impacts on their livelihood systems.

**Most income during flood periods is obtained from members of the family who have migrated and have work in other areas.**



*Commuting is difficult when roads are flooded.*

## SUMMARY OF INSIGHTS FROM CASE STUDIES AND REVIEWS

Despite the well documented stress associated with floods and droughts, disaster can also serve as a catalyst for changes in work patterns that result in gender, caste and social mobility.

Relief work for example, is generally taken up by women because it is closer to villages than other income-generating opportunities. While doing relief work is often an added burden, VIKSAT's experience<sup>13</sup> indicates that women are more keen than men to work on NGO initiated drought-relief projects as these tend to be investments in local water infrastructure – like deepening a village pond– which may reduce the burden women face and provide long-term livelihood sustainability. Although the impact of income from relief work, in particular the balance between payments in cash and food, is widely debated, targeting relief work toward activities that counteract the gender specific impacts of floods and droughts on women can give them the leverage needed to change their lives over the long-term.

The formation of NGO-supported SHGs, like GEAG's work in Gorakhpur, illustrates how women can be empowered.

Since 1996 in Gorakhpur District, GEAG has been organising rural women in Campierganj and Sardarnagar blocks into SHGs as a means of not only providing micro-

credit facilities, agricultural training and inputs such as seeds and bio-fertilizers to them, but also and more importantly, creating a forum for them to meet collectively in what is otherwise a very patriarchal social context. In addition, GEAG is currently working with three or four NGO partners in developing community-based flood mitigation models which address time and space management needs. These include quick-growing, water-resilient crop species, such as early varieties of paddy or sugarcane which bring increased benefits both in terms of income per unit area and the speed of maturation. In an attempt to strengthen women's livelihood resilience in the face of floods, GEAG has also been experimenting with the sale of ducks to some SHGs on a pilot basis.

Bahri Tola (Kailash Nagar) is one flood prone hamlets in Loharpurva Village, Campierganj Block. Which comprises backward and scheduled caste families including chamar, (blacksmiths), kevat and nishat (boatmen) caste groups. In May 2003 the ten members of the Ma Kali SHG, most of whom are landless women, took a bank loan to purchase ducklings as ducks are known to weather floods well and since a tremendous demand for duck eggs exists in local markets. As a result, egg production can generate a small, immediate source of income for women. Ducks also provide benefits with respect to paddy including

**Disaster can serve as a catalyst for changes in work patterns that result in gender, caste and social inequity.**

weeding, aeration and manuring. Of the IRs 1,000 the SHG borrowed, each woman received IRs 90 to buy 10 ducklings at IRs 9 per duck and the balance went to buy medicine. Table 45 shows the status of the ducks in November 2003. Two women, Indravata and Taramani, have lost all their ducks.

While ducks do provide nutrition to a family, particularly for children, and do have income-generating potential, there are a number of risks associated with keeping ducks, not least the menace of stray cats and foxes. Most of the women kept their ducks in small coops, which got congested as the ducks grew and the summer heat increased. On the whole, though, discussions with other SHGs which had also started similar initiatives revealed that ducks are easier to keep than chickens which, need constant attending to. Small inputs of this nature, while they initially have limited success, can over

the long-term, change the income flows women have control over in fundamental way.

Facilitating women’s participation in community institutions is another critical point of entry for mitigating the impacts of floods and droughts. Since the constitutional amendments in the early 1990s calling for reserving for women one-third of all seats in *panchayati raj* institutions (PRIs) at all levels of decentralised governance in India (district, block and village), there has been renewed debate on the merits of top-down reservation policies versus bottom-up approaches to capacity building. Neither course is mutually exclusive and any attempt to strengthen women’s adaptive capacity will have to work with layers of community institutions and a range of different strategies including separate women’s groups such as SHGs or *mahila mandals* and strengthening of women’s participation in mixed forums like

**Diversification of income generating strategies, often including different forms of migration and commuting was central to making livelihoods resilient and increasing the ability to recover after flood or drought events.**

Table 45: **Women Self-Help Programme, the Case of Ducks**

Name	Status of ducks	Benefits
Malti, group president	Three died. Of the 7 left, 1 was sold for IRs 75. She is left with 6 ducks of which 3 are hens	The ducks lay 1 egg a day which is sold @ IRs 2/egg. Earned about IRs 100 in one month. Sold in village
Kesari	Only 2 ducks remained	Only gets one egg a day, eaten by daughter
MonadeviSomna (joint family)	12 ducks remained from the 20 purchased, most died from heat and ill health	Sold two @ IRs 90 each, eggs consumed at home, large family, 15-16 members
Pushpa	Only 1 duck remained, cat ate 3-4 ducks, rest died of heat	
Sonera	4 ducks remained	Eggs sold and consumed at home
Sona	Only 7 ducks remained	Sold 2, 3 remained, plus 4 lay eggs which is consumed at home
Dharma	5 ducks remained	5 remained, some eggs sold, and some consumed at home

Source: Ahmed field visit, November 2003.

*panchayats*, village water and sanitation committees and village disaster management committees (whose number is now growing in many disaster-prone states). This does not mean that we can afford to ignore men in the discourse on vulnerability and disasters, but that we recognise, given the extent of male out-migration in all study areas, that building resilient community adaptive systems will need the simultaneous strengthening of women’s leadership roles and livelihood capacities. In addition, this approach cannot be divorced from the articulation of women’s fundamental human rights which are all too often violated in a disaster context. Women need to be made secure in their rights to life with dignity, to education and life skills, to freedom from sexual violence and to recognition for their enormous contribution of unpaid work to the maintenance and survival of disaster affected households.

**Small inputs can over the long-term, change the income flows women have control over in a substantial way.**

### Key Factors Contributing to Adaptation and Coping Capacity

Stepping back from the details of the case studies and the impacts on specific groups, such as women, it is clear that a wide variety of factors contribute to the ability of households and communities to both adapt to and cope with climatic variability and the direct impacts of floods and droughts. The discussion below highlights the individual factors that our research suggests play distinct roles: Income diversification and migration, the presence of institutions, the availability of flood- or drought-adapted technologies, basic communication and transport infrastructure. Before exploring these factors individually, however, it is essential to emphasise that in all situations a combination of factors was present and responsible for shaping the systemic context in which households adapted to drought and flood. Income diversification, for example, would have made little difference in the absence of a secure source of domestic water supply to meet survival needs. Similarly, the existence of flood-adapted shelter technology – a flat cement roofing – makes little difference unless a household has access to remittance flows from migrants or some other source of capital to build a house with that feature. The role of each individual element or strategy in mitigating flood and drought impacts depends on the existence and strength of other complementary strategies. This important point must be recognised in the attempt to strengthen the resilience of livelihood systems.



Ducks are household level assets.

## Income Diversification and Migration

In all flood and drought case study areas, income diversification was as a major strategy households either proactively engaged in or resorted to as a response to floods and droughts. Those households with access to diverse income sources were in a far better position to deal with the livelihood and other impacts of floods and droughts than those without. Key forms of livelihood diversification included the following:

1. *Establishment of at least one family member in a secure, preferably local, non-agricultural occupation:* While our study did not generate sufficient information to document the different dimensions of this strategy in detail, discussions with villagers suggest that it is likely to be particularly effective when the income source is relatively local – i.e. accessible by commuting or within local villages rather than long-distance.
2. *Development of permanent non-agricultural based livelihood sources within villages:* In some Rajasthani villages where surveys were conducted, for example, all caste groups have become woodworkers who make furniture and other items for sale. Agriculture and animal husbandry are still practiced but only as secondary occupations. In many areas of Gujarat, diamond polishing has become a major activity that complements income from agriculture and animal husbandry. As the box on Coimbatore included
3. *Shifting the structure of natural resource based-livelihood activities to accommodate flood and drought impacts:* Farmers in Rajasthan and Gujarat, often decreased their dependence on agriculture and increased the role of livestock in response to drought. Similarly, in UP local communities in areas where floods had devastated agriculture increased their income by fishing.
4. *Temporary and Permanent Migration:* Migration plays a central role in the strategies households use to respond to both floods and droughts. Seasonal migration to adjacent or distant agricultural regions as agricultural labourers; or to urban areas to access construction and other temporary wage labour activities helps maintain income levels. In some cases seasonal migration strategies have actually evolved into well-developed business practices. For example, individuals from in one Rajasthani village surveyed migrate to urban areas to sell ice cream during the hot summer season. The economic niche they have found represents a major income source for the individuals involved. In addition to temporary migration, households and individuals often migrate on a permanent basis when they are able to obtain jobs or develop solid

earlier in this document indicates, other similar shifts have occurred in areas where non-agricultural opportunities exist.

**A wide variety of factors contribute to the ability of households and communities to both adapt to and cope with climatic variability.**

businesses in urban areas and thus reduce their dependence on flood and drought-affected livelihoods.

5. *The role of remittance flows:* Remittance income from migrants was frequently mentioned as an important resource for recovering from floods and droughts. The extent of this remains, however, unclear. In some cases households reported that they received relatively low levels of income from members who worked outside the locality and that migrants often become divorced from joint-family economic groupings and have little incentive to contribute income to the joint pool in times of need. In other situations, however, remittances to and investments in home areas by migrants are huge. They probably represent the largest source of capital for investment in schools, wells and other basic infrastructure that improves livelihood resilience. Migrants from Kutch, for example, often

finance local NGOs and SHGs. The development of effective local institutions supported by remittance income flows could become a potentially important way of improving livelihood resilience in many drought and flood-affected areas. The role remittance flows could play in enabling regions to adapt needs additional investigation. As is the case in other parts of the world,<sup>13</sup> empirical evidence on the specific role of remittance flows is lacking.

6. *Selection of crop varieties:* In both flood and drought areas, careful selection of crop types and varieties was central to the ability to adapt to and cope with floods and droughts. In Gujarat, for example, as drought conditions became more intense, farmers often allocated available water supplies to the production of fresh fodder. This enabled them to use markets as a source of dry fodder (the purchase of dry fodder from other

**Remittance income from migrants was frequently mentioned as an important resource for recovering from floods and droughts.**



Members of women saving group.

regions being, in essence, a flow of virtual water) and thus maintain the milk production of and the resultant income from their livestock. Similarly, farmers in case study locations in flood-affected portions of Nepal and India often selected different varieties of rice or cultivated different crops in order to reduce the vulnerability of agriculture to anticipated flood conditions. Overall, diversification and change within the agricultural system appeared to be nearly as important to overall income diversification as was the pursuit of non-farm activities.

Large differences in households' ability to employ the above strategies were observed in all case study areas. Many non-agricultural activities, particularly those involving migration, are male-dominated and the income from them tends to be controlled by males. In addition, some forms of diversification, such as access to good jobs in the government or other businesses, are affected by factors such as caste and educational levels.

### Transport and Access to Markets

The role of transport was directly emphasised in flood-affected case study areas and our observations suggest clearly also played a major role in the ability of households to adapt in drought-affected regions.

Interviews in the flood-affected sections of India and Nepal often highlighted problems related to the transportation of everything from people and

household goods to fodder and marketable products. Roads are often flooded and in many instances, block drainage and concentrate flood flows in a destructive manner. As the case studies above illustrate, people have developed innovative means of transport in flood situations, including using traditional beds, large cooking pots and tractor tubes as small boats or rafts. Such traditional responses are often, however, of limited effectiveness. Villagers often stated, for example, that they can only be used in calm water and are not capable of transporting large volumes or weight. As a result, the ability of people to transport key items both locally (among houses within villages) and over distances (to markets or centers where services are available) remains a major problem. In some flood-affected areas the lack of transport was cited as a specific limitation on the ability of local communities to access markets for products, such as fish, that are available during flood periods.

Just as the lack of transportation systems poses a major problem in flood-affected areas, case study results from Rajasthan and Gujarat indicate that transport infrastructure plays a major role in enabling communities to adapt to droughts. During the recent droughts established transportation systems enabled fodder to flow into many rural areas (thus enabling families to increase their dependence on animal husbandry). It was also critical for non-agricultural activities. Furniture making could, for example, be established in rural areas and

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**The role of transport was directly emphasised in flood-affected case study areas and, while not directly emphasised, clearly also played a major role in the ability of households to adapt in drought-affected regions.**

people could migrate or commute out to jobs primarily due to the transport network. Roads also enabled both private and government tankers to provide water for domestic uses.

Overall, the presence of effective transportation systems is absolutely central to the ability of communities to adapt to droughts and their absence is a basic limitation on adaptation possibilities in many flood-affected areas.

### Flood and Drought Adapted Infrastructure

The role of infrastructure that is well-adapted to flood and, to a perhaps lesser extent, drought conditions emerged as a central factor ameliorating livelihood impacts in most of the case study areas. In flood-affected regions, individuals interviewed pointed to the key role played by:

1. *House construction:* Raised plinth heights, cement or baked brick instead of mud walls, and flat roofs on which temporary or permanent protective structures could be built played a major role in enable households to cope. Secure flat roofs are of particular importance as place to store assets (grain, equipment, etc.) away from flood waters.
2. *'Island' designs for villages:* Throughout the Ganga basin, attempts to increase village heights above normal inundation levels is a traditional response to floods. This approach was mentioned by villagers in many case study areas and presented in direct contrast to

approaches relying on the building of embankments.

3. *Construction of water supply systems that are resilient to contamination:* Sealed wells accessible by handpumps at roof level were found in some cases.
4. *Flood drainage systems (or the lack thereof):* In many cases, villagers in flood-affected areas identified poor drainage as a major factor contributing to flooding and the negative impacts associated with it. It is important to develop designs for roads, railways and other infrastructure that encourage rather than restrict drainage.
5. *Construction of irrigation systems that are resilient to flood damage:* In many areas, damage to permanent diversion structures is difficult to repair and can cause streams to shift. Traditional systems often use structures such as brushwood dams that, while they are easily damage, are also easily repaired and do not cause permanent changes in stream morphology.

Drought-adapted infrastructure focused on technologies to increase access to water. People tended to emphasise the role played by local wells and water harvesting structures and to emphasise the problems that emerged when such sources failed. Water tankers and the roads were also frequently noted as key (though often, from the perspective of villagers, problematic) sources of water supply. Purchase was mentioned in

**The role of infrastructure that is well-adapted to flood and, to a perhaps lesser extent, drought conditions emerged as a central factor ameliorating livelihood impacts in most of the case study areas.**

many areas as a key source of water in many areas, a finding that parallels that of the Rajasthan Akal (drought) survey undertaken last year by Sivakumar and Kerbart. About 40% of those surveyed reported having to purchase water.<sup>14</sup> Tanker and other water markets are clearly an important element in the current processes of adaptation to water scarcity and drought.

### Communication Systems

Many of those interviewed either explicitly or implicitly mentioned the lack of advance warning as a major constraint on their ability to mitigate the adverse impacts of both floods and droughts.

In the case of floods, individuals often stated that they were unaware of approaching high flows and had little news regarding weather conditions upstream until just before the flooding actually occurred. This said, many individuals also commented that flood issues were highly localised and that they varied from year to year. Flood levels depend on a variety of local factors, such as whether or not adjacent rivers rise at the same time, whether drainage points became blocked and whether roads, embankments and other man-made structures blocking the spread of water failed. As a result, some individuals indicated that they required locally-nuanced information that goes beyond the weather conditions in the upper parts of the watershed to determine whether or not and what type of mitigating action to take in response to flood threats.

Although many individuals complained of the lack of access to weather and flood-related information, opportunities to communicate such information appear to be increasing in most of the flood-affected areas surveyed under this study. Even in rural portions of Eastern UP, for example, cell phone service is available in many locations. In the rural areas of Nepal, local FM stations are now common and have a wide audience.

Where droughts are concerned, lack of access to weather-related information regarding the likelihood of droughts was rarely mentioned by those interviewed. Even so access to certain types of information clearly is critical. For example, even though groundwater levels have been falling for decades in many drought-affected areas, farmers often make substantial investments in deepening their wells even those in locations where, due to regional geologic conditions there is little likelihood of success. In Statlasna, one of VIKSAT's field locations, unsuccessful investment in well deepening was a major factor underlying the impoverishment of several families. Since drought impacts are, in many ways, as dependent on groundwater conditions as they are on weather patterns, information about the former needs to be disseminated.

Overall, communication of existing weather-related information as well as of information on groundwater conditions and the susceptibility of local areas to flooding is important in terms of the response strategies it catalyses among populations at local levels.

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**Many of those interviewed either explicitly or implicitly mentioned the lack of advance warning as a major constraint on their ability to mitigate the adverse impacts of both floods and droughts.**

### Social Institutions and Networks

The role of social institutions and networks in mitigating flood and drought impacts is a final element that emerged regularly in interviews and discussions with people in case study areas. This role was generally described obliquely and our perspective is interpretive, based as it is on impressions rather than quantifiable indicators.

The role of institutions and networks came out in comments on, for example, the factors determining access to loans, the rate of interest changed and access to jobs. Connections – knowing someone in an urban area who ‘understands the job market,’ having relatives with good jobs and the ability to lend money, being able to stay with an uncle or having friends in a business – seemed to play a major role in the ability to diversify or obtain funds when required. The importance of institutions and networks also came out in comments on the role different formal and informal organisations played in drought and flood relief. In drought-affected areas, for example, the role of cooperatives in fodder distribution was frequently mentioned as important. Similarly, in flood-affected areas people mentioned access to administrative offices, NGOs and their own SHGs as important.

SHGs appeared particularly significant in minimising the differential impacts of flooding and droughts on women. As the case studies and literature review clearly document, women

often lose more assets than men (in part because jewelry, their main asset, is often sold) and, equally importantly, lose control over income sources. SHGs which enable women to obtain income and access to loans independently of their family thus play a particularly critical role in their ability to develop resilient livelihoods.

In many situations, the role of institutions and networks appears to be enabling rather than direct. That is to say, they enable individuals to obtain access to resources rather than providing them directly. Cooperatives, for example, did not (as far as we are aware) actually provide fodder to members; instead, they served as ‘market makers,’ transporting fodder and enabling members and non-members alike to buy it. Often NGOs did not provide resource either; instead, they enabled local inhabitants to obtain access to government programmes or to disaster relief materials. Similarly, the presence of family and friends in urban areas or businesses often did not translate directly into a job but instead provided access to areas where jobs existed and access to knowledge of the job market.

Overall, the role of institutions appears best classified into several catalytic functions:

- *Information Access:* Social networks served as conduits for information on where jobs or other resources were to be found along with insights on how to obtain access to such resources;

SHGs appeared particularly significant in minimising the differential impacts of flooding and droughts on women.

- *Capacity Enhancement:* Institutions provided local areas with the capacity required to apply for and obtain access to, for example, bank loans and resources available through government programmes. They also helped population to organise and approach problems as groups rather than as disconnected individuals;
- *Direct Access to Financial and other Resources:* In many cases, membership in a social network (an extended family, an SHG or other organisation) provided direct access to key resources. This could be, for example, in the form of emergency labour to harvest crops threatened by flooding or through the provision of small loans to spend on subsistence needs or to invest in livelihood activities.

Each of the above functions had a critical, though often subtle, role in the ability of families to adapt to or recover from flood and drought conditions. In general, it appeared that those individuals with access to more extensive social networks and more diverse institutions were able to obtain access to a much wider array of resources when needed than those whose access to institutions and networks was more curtailed. In the Nepal Tarai, for example, villages adjacent to areas where government and non-government organisations are concentrated tend, not surprisingly, to have access to a much more diverse array of support during times of crisis than more isolated villages. Individuals

in UP and Gujarat who had access to organisations such as VIKSAT or GEAG also received key support that enabled them to adapt much more effectively than isolated individuals did to droughts and floods. This was also the case with regional organisations such as co-operatives and markets that enabled goods to flow. Similarly, individuals who have membership in large extended families or are part of SHGs or co-operatives are often able to obtain access to resources while other less well connected and supported individuals are unable to.

The fact that government, non-government and private sector organisations as well as markets play different roles illustrates the many layers of institutions affecting vulnerability and resilience. Lack of access to banks and the unwillingness of formal financing institutions to provide consumption loans for drought and flood recovery, for example, are a major factor forcing people to depend on local moneylenders and pay the much higher rates they charge. As this example illustrates, higher level institutions can either be enabling or constraining. If banks provided loans for any purpose where there was a reasonable chance of repayment, they could enable flood and drought recovery. When loans are limited to specific uses (such as agriculture) they constrain access and limit the development of adaptive, diversified livelihoods. Another dimension of social networking involves the interlinked functionality of institutions. Local SHGs, for example, are likely to

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**The fact that government, non-government and private sector organisations as well as markets play different roles illustrates the many layers of institutions affecting vulnerability and resilience.**

be much more effective when they have institutional support from an NGO and also when the larger institutional and physical infrastructure allows them access to markets, transport and credit.

### Income and Physical Assets

The final, and least surprising, element of adaptability that came out clearly in all case study regions was income levels and physical assets. Income and, in a more general sense, physical assets tend to be strongly correlated with everything from social networks to education. Households which have substantial capital tend to be among the least affected by droughts or floods and also among the first to recover. It is important to recognise, however, that the relationship between assets and adaptive capacity is not necessarily an inherent one. In some case study areas, such as the field site at Satlasana in Gujarat, relatively wealthy groups were heavily affected and possibly less well able to cope with drought than less wealthy groups in the same area. The example of Satlasna illustrates this well.

In Satlasana, the Darbar community, a farming community where individual households generally have substantial assets in the form of land, was among the most affected by the drought. Members of this community generally practice irrigated agriculture and have enough land that they do not need to engage in other forms of livelihood activity. Being skilled farmers, they have little experience and no tradition

of involvement in wage labour or business. During the drought in Satlasana, most of the wells in the region went dry and virtually no water was available for irrigated agriculture. Many Darbar households responded by taking loans and investing then accumulated assets in the drilling of new, far deeper wells. Such investments were frequently unsuccessful because groundwater pumping in the region had already depleted the reserves available in the upper alluvial aquifer, which is underlain by bedrock with few fractures and little water storage. As a result, investments in new wells generally did little to improve the viability of irrigated agriculture. In some cases, Darbar families lost majority of their assets in a futile attempt to maintain a form of livelihood that, at least during the drought, was unsustainable.

During this drought many Darbar households appeared to have far less adaptive capacity than their less well-off neighbors, who had substantial experience with the wage labour markets. Darbars were forced to enter the agricultural and other wage labour markets but, in many cases interviews suggest that they had few contacts and little familiarity with the locations and types of work likely to be available.

While the long-term impacts on the Darbar community have yet to be investigated, the pattern outlined above highlights the fact that financial assets alone are insufficient as an indicator of

**It is important to recognise that the relationship between assets and adaptive capacity is not necessarily an inherent one.**

vulnerability. When groups are engaged in narrowly-based forms of economic activity, vulnerability depends not on wealth but on the factors affecting the sustainability of that narrowly based livelihood system. When long-term processes of environmental degradation, such as groundwater overdraft, coincide with natural climatic variability, vulnerability can increase dramatically. It is important to recognise that this type of vulnerability is not confined to drought situations. In flood-prone areas, for example, increasing drainage congestion (a long-term process of environmental degradation similar to groundwater overdraft) increases the flood vulnerability of any livelihood system where fundamental assets are subject to destruction when flooding occurs.

### Domestic Water Supply

In both flood and drought situations, access to secure sources of water for domestic uses was identified as a central issue by local populations. During droughts case, the physical availability of water for domestic use is often a central concern, while in the case of floods, water quality (pollution) is the limiting factor. In both cases, however, access to good quality water for domestic use is essential if individuals/households are to remain in their homes and avoid forced displacement. Furthermore, in both cases access to a sufficient supply of good quality domestic water has direct implications for both health and livelihoods.

**Health:** During floods and, to a lesser extent, during droughts disease is a major concern.

Virtually all villagers in flood-affected areas raised the issue of flood-related illnesses. Although our survey did not quantify the illnesses mentioned by type, many are gastro-intestinal and related to the use of contaminated water for drinking and other domestic purposes. While many responses related to other health issues, our focus here is on the link between that and secure domestic water supply sources.

Households are often aware of the link between disease and polluted sources of supply for domestic water needs. They try to address it by, for example, boiling their drinking water. The lack of dry fuel, however, often limits their ability to do so. The lack of safe water is further complicated by the presence of sediment and of on-going pollution loads including direct defecation into floodwaters. As a result, the water available for all uses – hand washing, bathing, laundry, animal use, and so on – is highly polluted and the pathways for disease transmission many.

The health impact of limited drinking water availability in drought areas comes through several channels. First, in many drought-affected areas where local water supplies have dried up, the collection of water is, in itself, a major task involving many hours of work under extreme conditions. Individuals, particularly women and children, often have to walk many kilometres under the hot sun in order to meet the needs of their family. The physical labour can wear down people's resistance to disease itself. In addition, villagers often reported increases in diarrhoea

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**Many of the above strategies for coping with floods may appear simple and, in relation to the impacts of flooding, at best partial. Both characterisations are on many levels accurate. This said, the strategies reflect underlying factors that are central to both livelihood resilience and adaptive capacity.**

In both flood and drought situations, access to secure sources of water for domestic uses was identified as a central issue by local populations.

and other water related diseases. Almost two decades ago it was recognised that the amount of water available for personal and domestic hygiene is as important a determinant of a community's health as the quality of that water.<sup>15</sup> Whatever the quality, the transmission of major infectious agents of diarrhoea can be greatly reduced by the presence of sufficient water for washing hands, utensils and food. Furthermore, a major review of the literature on water quantity found that small increases in water availability (up to 20 l/capita/day) often had substantial health benefits although the benefits of larger increases could not be documented.<sup>16</sup> A review conducted shortly after this pointed out that in many cases 'endemic transmission of disease is not waterborne but water washed ... in most health impact studies in which significant reduction in diarrheal disease was detected, there had been improved access to water in quantity. In many studies that failed to detect an impact, only water quality had improved.'<sup>17</sup> Water washed diseases, which are transmitted due to the lack of water for personal and domestic hygiene include not only diarrhoea (cholera, dysentery and unspecified diarrheas) but also worm (roundworm, hookworm, pinworm, guineaworm, schistosomiasis) skin conditions (scabies, fungal ringworm, louse-borne typhus) and eye infections (trachoma, conjunctivitis).

In many of the areas in Gujarat and Rajasthan where surveys were conducted for this project, the daily

water supply availability for domestic use was well below the 20 litre per capita level identified over two decades ago as the basic amount needed to maintain good health.

**Livelihoods:** The link we have just discussed between domestic water availability and health has major implications for livelihoods. Disease reduces the availability of workers and the energy they can devote to productive livelihood activities. This link, which is widely recognised in development literature, came out clearly in many of the discussions we held with local villagers during the study.

Beyond this, link however, it is important to recognise that in both flood and drought cases, substantial amounts of labour are devoted to the procurement of safe domestic water supplies. In drought areas this typically involves women and children walking long distances or waiting substantial amounts of time in order to obtain water for household use. In flood-affected areas, while obtaining water *per se* is not time consuming, collecting of sufficient dry fuel to boil it – or even the process of boiling water with damp fuel – can be.

Overall, it is not just the labour that must be devoted to water collection and treatment that undermines livelihoods, it is also the time that must be diverted from other productive activities. Whether walking long distances to collect water or waiting for tankers to come or supply

systems to be turned on, time and energy must be diverted from other activities. Women are thus rendered unable to engage in other livelihood activities and children are forced to

discontinue their education. Similar impacts on education and livelihoods in the case of the drought in Rajasthan and Gujarat have been noted in other studies too.<sup>18</sup>

## End Notes

<sup>1</sup> Mudrakartha, Madhusoodhanan *et al.* (2003)

<sup>2</sup> Sivakumar and Kerbart (2004)

<sup>3</sup> Scheduled Caste

<sup>4</sup> 'Other Backward Caste' (A specific designation for backward castes not listed on the formal government schedule of backward castes).

<sup>5</sup> Scheduled tribe

<sup>6</sup> This study does not address the migration of humans along with livestock as that is a traditional and well known practice among people living in Western Rajasthan. For details, see Kavoori (1999).

<sup>7</sup> Low land situated closed to the river in eastern Uttar Pradesh and Bihar, and subject to frequent flooding.

<sup>8</sup> Land situated between two rivers. (*Doab* is a Persian word, which means "Two streams of water")

<sup>9</sup> Local governance unit of a village

<sup>10</sup> Murthy (2000); Wajih (2000).

<sup>11</sup> Deposition of sand on agricultural fields by floods.

<sup>12</sup> In Nedardi village during 2000 with support from Oxfam.

<sup>13</sup> Adger, Kelly *et al.* (2002)

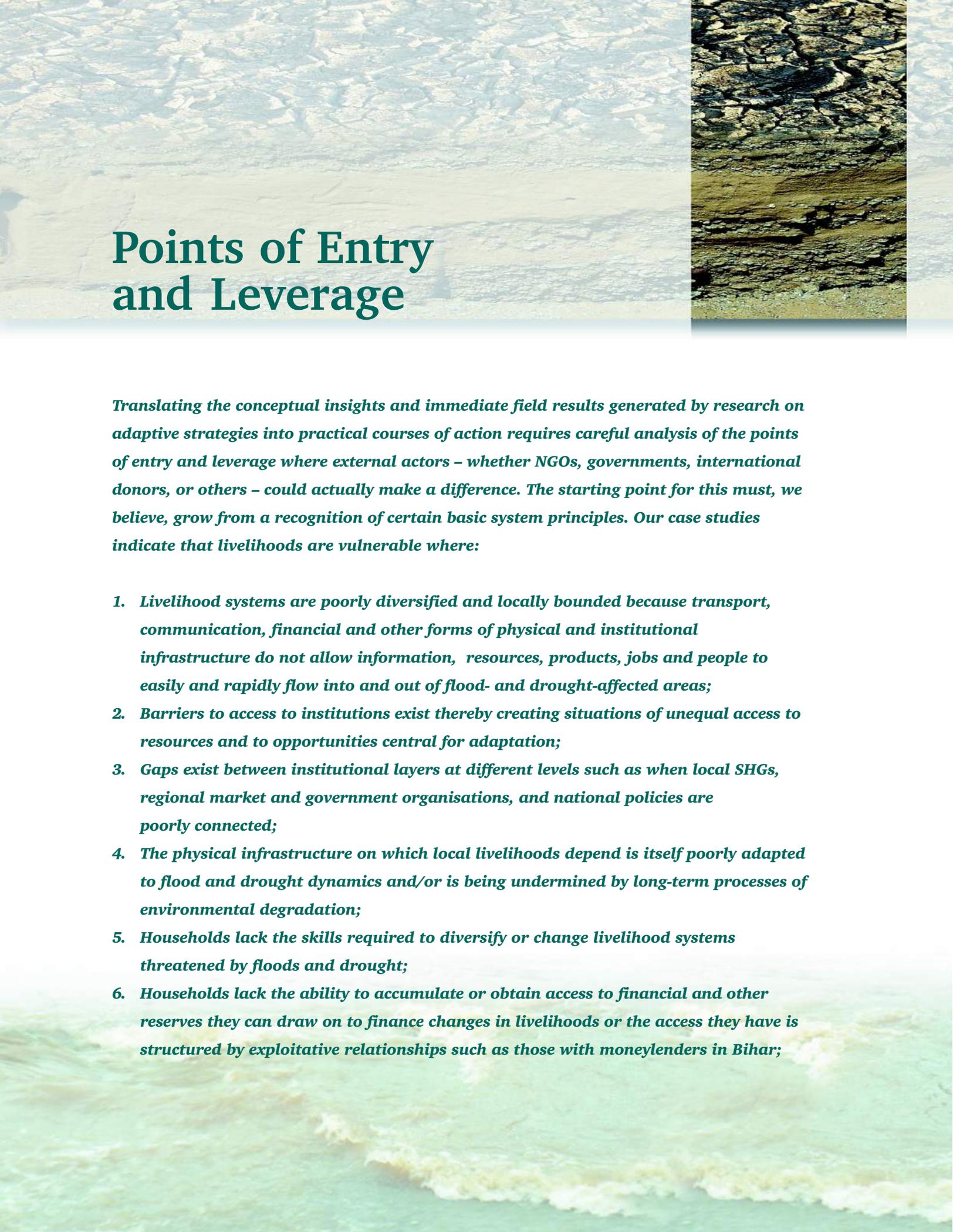
<sup>14</sup> Sivakumar and Kerbart (2004)

<sup>15</sup> Esrey and Habicht (1986)

<sup>16</sup> Esrey and Habicht (1986)

<sup>17</sup> Aziz, Hoque *et al.* (1990)

<sup>18</sup> Sivakumar and Kerbart (2004)



# Points of Entry and Leverage

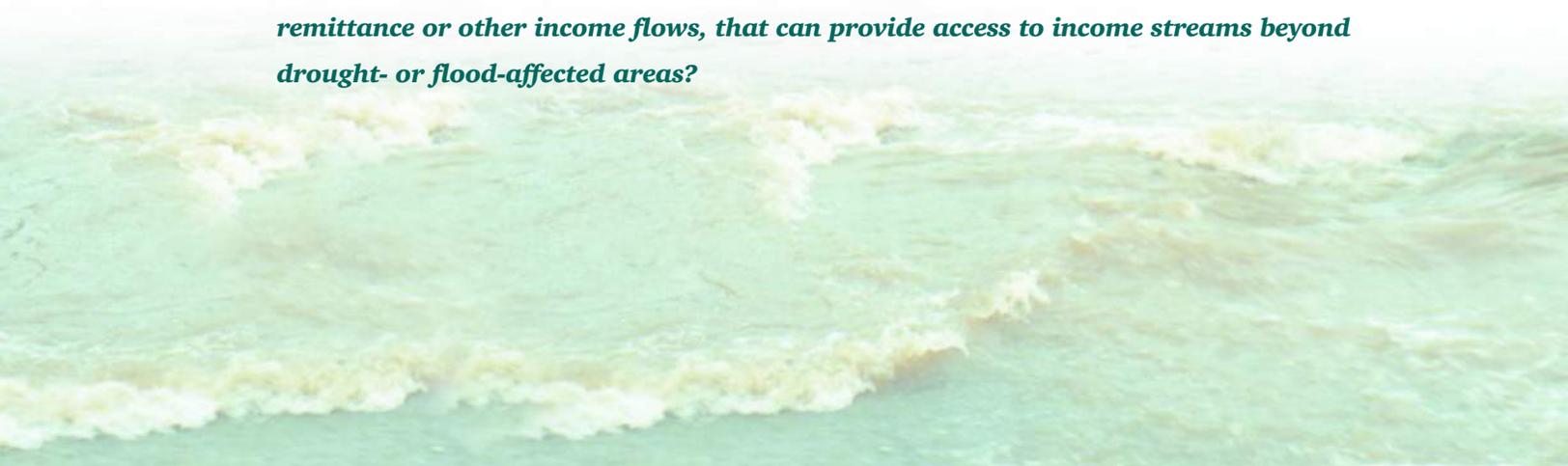
*Translating the conceptual insights and immediate field results generated by research on adaptive strategies into practical courses of action requires careful analysis of the points of entry and leverage where external actors – whether NGOs, governments, international donors, or others – could actually make a difference. The starting point for this must, we believe, grow from a recognition of certain basic system principles. Our case studies indicate that livelihoods are vulnerable where:*

- 1. Livelihood systems are poorly diversified and locally bounded because transport, communication, financial and other forms of physical and institutional infrastructure do not allow information, resources, products, jobs and people to easily and rapidly flow into and out of flood- and drought-affected areas;*
- 2. Barriers to access to institutions exist thereby creating situations of unequal access to resources and to opportunities central for adaptation;*
- 3. Gaps exist between institutional layers at different levels such as when local SHGs, regional market and government organisations, and national policies are poorly connected;*
- 4. The physical infrastructure on which local livelihoods depend is itself poorly adapted to flood and drought dynamics and/or is being undermined by long-term processes of environmental degradation;*
- 5. Households lack the skills required to diversify or change livelihood systems threatened by floods and drought;*
- 6. Households lack the ability to accumulate or obtain access to financial and other reserves they can draw on to finance changes in livelihoods or the access they have is structured by exploitative relationships such as those with moneylenders in Bihar;*

7. *Institutions do not exist or households lack access to institutions that sustain themselves during normal periods as well as in times of crisis and that enable local populations to organise responses; and*
8. *Basic resources for physical survival - such as access to unpolluted drinking water - are threatened.*

*What is needed is an approach to development and disaster mitigation that emphasises points of entry targeted toward reducing or circumventing constraints in livelihood systems that create or reinforce the factors of vulnerability identified above. The goal is to create layers of supporting institutions, infrastructure, resources and capacities that allow households at local levels to obtain access to diverse income streams and to shift the structure of livelihoods as conditions continuously evolve. Linking disaster mitigation with long-term development processes is key. This aim is very general. What does it mean on a more tangible level? To us, tangibility requires understanding what people are already doing to help themselves and the incentives that underlie the courses of action they choose. In specific situations it requires asking questions of the following type:*

- *Does the physical and institutional infrastructure (the transport, communication, banking, transportation, and water supply systems) available at both local and regional levels enable the flow of information, goods and people into and out of areas as needed, particularly during times of flood and drought?*
- *Are there organisations, whether at the community level in the form of SHGs or at higher levels, that provide a platform for organisation, asset accumulation and access to resources in normal times and during periods of stress?*
- *Are livelihood systems within the area diversified and, if not, are there particular points where current livelihoods are particularly vulnerable to floods or droughts?*
- *Are local-level households of different types able to access higher level institutions such as markets, financial organisations, government departments and so on?*
- *Are there any social networks, particularly ones that involve migration and associated remittance or other income flows, that can provide access to income streams beyond drought- or flood-affected areas?*



- *Do populations have the skills and other assets required to diversify livelihood strategies when needed?*
- *Can information flow easily into and out of areas and, in particular, does the communication system enable households to obtain information on weather, jobs, market conditions and other critical topics on a timely basis?*
- *Is the infrastructure in an area 'alive' (i.e. in use all of the time and sustained by the multiple services it provides) or is it falling into disrepair due to infrequent use?*
- *Is the physical infrastructure well adapted to both the historical patterns of floods and droughts and to the inherent uncertainty regarding future conditions? More specifically, does the physical infrastructure depend on systems functioning within narrowly defined flow or other parameters or is it able to cope with large variations and uncertainty?*
- *Have current patterns of development support or disaster mitigation increased vulnerability by reducing exposure to normal climatic variability and thereby reducing the incentive to adapt livelihood systems?*

*Questions like those above are, in many ways, a repetition of the factors we see as contributing to vulnerability and adaptive capacity. They are important to highlight, however, because they represent tangible starting points for the identification of practical points of intervention that can make a difference in specific situations. Since different regions and different populations within regions will score differently with respect to each of the questions their answers will lead to different courses of action. In some cases, the result will be the identification of key vulnerable groups that lack access to resources essential for adaptation; in other cases answers will lead to the identification of the need to establish core physical infrastructure such roads, financial institutions and markets. The specific interventions appropriate for any given area will vary; the thread of commonality lies in the recognition that specific issues are the outcome of systemic constraints and the acceptance of an approach which identifies points of entry to changing the structures that create vulnerability.*



## TRANSLATING CONCEPTS INTO PRACTICE

Translating the insights generated by projects such as ours into practice requires at least four things:

1. Catalysing complementary forms of investment (not always financial) in communities, markets, communications, education, governmental institutions and physical infrastructure that together provide a foundation for adaptation;
2. Processes that external actors (whether governmental, non-governmental or donor initiated) can use first to identify specific points of entry that will enable adaptation and the development of resilient livelihoods. Actors need to identify key constraints and dimensions of vulnerability where strategic support could catalyse or support adaptive processes;
3. Pilot activities that test approaches to implementation and enable learning regarding the effectiveness of both processes and the complementary investments they catalyse with respect to their ability to build resilience and adaptive capacities; and
4. Continued efforts to build our scientific understanding of the natural and social processes affecting adaptive capacity and to create mechanisms to channel this increased understanding back to implementation.

Each of these concepts is explored in detail below.

### Catalysing Complementary Forms of Investment

Linking disaster mitigation to development requires recognition of the complementary roles different forms of development play in the creation or reduction of disaster vulnerability. Normal developmental activities are likely to increase the resilience of livelihoods when they build on opportunities people already exploit, encourage livelihood diversification and facilitate the flow of information, finances, goods and people within and between regions. Furthermore, livelihood resilience is likely to increase only if the institutional and social infrastructure created is itself resilient to disruption and if development activities also strengthen the institutional capacity, skills and educational levels of local communities so that they are able to take advantage of wider opportunities and protect themselves from exploitation.

What might this mean in practice? The case of SHGs is instructive. The effectiveness of SHGs in both development and disaster mitigation is likely to be increased if the groups are strong enough to attract investment from external sources. In some parts of the world, notably Yemen and Gujarat, local groups obtain substantial financing via remittance flows from external migrants. In many cases, such

**We need to recognise the complementary roles different forms of development play in the creation or reduction of disaster vulnerability.**

funds are utilised to finance schools, water supply systems, roads, and power systems – all infrastructure which can have a huge multiplier effect on the resources the group itself can generate. The effectiveness of SHGs is likely to increase if they are formally recognised and thus able to interact with governmental organisations such as *panchayats* and obtain resources from banks and other organisations operating in the formal sector. Similarly, SHGs have more income opportunities when physical infrastructure (such as roads) improves physical access to markets and when communication infrastructure (like roads, radio, and TV) enables them to obtain a diverse array of information regarding opportunities (market conditions) and risks (weather). Finally, the capacity of an SHG increases when its members have the education and skills required to take advantage of the opportunities and respond to the stress introduced as conditions change.

If, as part of the normal development process, the capacity of SHGs is strengthened then they are likely to be more effective in mitigating the effect of disasters. Furthermore, SHGs are likely to mitigate impacts on vulnerable groups either if they focus on such groups (i.e. as in the case of women’s organisations) or if they employ effective mechanisms to ensure the equitable representation of the vulnerable in group decision-making and activities. The process of developing organisations and helping them link effectively with wider social

institutions while at the same time reducing social asymmetries is a key example of how development and disaster mitigation can be linked. Investment in organisations such as SHGs could, as a result, serve as a catalytic point of entry for both development and disaster mitigation.

The SHG example above applies to many other forms of institutions as well. Cooperatives, micro-finance and private sector organisations can all play similar roles. The role micro-finance can play in disaster risk management is, for example, globally recognised.<sup>1</sup> It is important to emphasise, however, that catalytic investments in physical infrastructure can be as, or in some cases more, important than in social organisation. This is clearly evident in the roles played by roads and houses, as described below:

- **Roads:** In the Gujarat drought the presence of an extensive road network enabled fodder and water to flow to people rather than vice versa;
- **Housing stock characteristics:** In all the flood-affected areas, houses with solid flat roofs and protected hand-pumps served as critical pieces of infrastructure that substantially reduced vulnerability by protecting assets and providing drinking water, thereby enabling livelihoods to continue without displacement. Similarly, in drought affected areas, water storage tanks or cisterns help to supplement supplies through rooftop rainwater

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**The case studies demonstrate both a great commonality among responses and the highly diverse nature of local contexts.**

harvesting and also serve as containers in which families can store water purchased from tankers.<sup>2</sup> The livelihoods benefits associated with these housing stock characteristics go far beyond the water itself. Household tanks, for example, free up time and labour (typically women's) for investment in more productive activities. The importance of shelter sector activities has been noted in other areas.<sup>3</sup>

Other forms of physical and communication infrastructure probably play similar roles. Infrastructure needs to be analysed from the perspective of the role it plays as a platform for diverse action rather than as a specialist input itself. Regional development approaches could reduce disaster vulnerability by focusing on the construction of flood- and drought-adapted infrastructure, providing the core communications and transport networks required to access diverse income sources, and developing local and regional institutional capacity. These catalytic entry points would enable local populations to invest on their own and to adapt or diversify livelihood strategies in a myriad of ways. Other, similar strategies could also translate into approaches to disaster relief that contribute to long-term development. Reconstruction of houses in flood-prone areas, for example, could emphasise the building of *pakka* flood-resistant houses rather than simply replacing existing structures.

## Catalysing Processes that Foster Resilience and Adaptation

The case studies demonstrate both a great commonality among responses and the highly diverse nature of local contexts. While many of the broad factors enabling adaptation to climatic variability, such as livelihood diversification, are clear and relatively universal, specific options for achieving diversification depend heavily on local conditions. For this reason we believe approaches to development and disaster mitigation must combine high-level recognition of the large systemic context and the strategic points of entry it suggests with approaches that are rooted at the community and household levels. This means that development and disaster mitigation processes must be driven at both community and higher levels.

At the community level, processes that enable communities to identify the primary constraints and incentives they face in relation to floods and droughts and the forms of support that might assist them must be developed. The points of leverage where catalytic inputs could actually change such constraints and build upon locally available opportunities must, at the same time, reflect wider perspectives on regional economic, hydrologic and other systems.

Although approaches to development or disaster mitigation have focused either at the community level or been driven by high-level government departments and NGOs we believe that processes

**Developing local and regional institutional capacity as catalytic entry points can enable local populations to invest on their own and to adapt or diversify livelihood strategies.**

which balance both perspectives are essential. Such processes are not driven by development actors (i.e. we are not talking about the process of initiating specific projects) *but they can be catalysed*. To be more specific, our research indicates that development and disaster mitigation processes are an outcome of interactions in situations where community, governmental, NGO, media and market institutions counterbalance each other and together enable society to identify issues, needs and opportunities as they arise. Catalyzing this is central to long-term development and immediate disaster mitigation. Elements that could contribute to the development of such a process exist but have not yet been synthesised. They include:

1. *The development of improved vulnerability indicators.* Being able to pinpoint the degree of livelihood diversification in a region would, for example, be useful in identifying flood and drought vulnerability. Similarly, levels of groundwater overdraft and rates of declines in water levels could serve as primary indicators of approaching drought vulnerability and the need to direct livelihoods away from reliance on irrigated agriculture. Other indicators of vulnerability include the following:
  - a. **Physical:** Drainage congestion, lack of access to secure drinking water supplies.
  - b. **Economic:** Low levels of diversification, poorly developed markets.

- c. **Demographic:** Little possibility of commuting.
  - d. **Infrastructure:** Poor communication and transport facilities, infrastructure that is poorly adapted to flood and drought conditions.
  - e. **Institutional:** Absence and lack of access to local, regional and national institutions.
2. *The development of social auditing institutions and analytical processes that assist communities and external actors in identifying points where catalytic inputs (whether in the form of physical infrastructure or institutions) could address the root systemic factors creating vulnerability and limiting adaptation.* Many of the PRA processes which have evolved over the last two decades for working with communities could play a role in this development.

Our research indicates that development and disaster mitigation processes are an outcome where community, governmental, NGO, media and market institutions counterbalance each other and together enable society to identify issues, needs and opportunities as they arise.



Sand mining is a source of livelihood for the poor but also seriously degrades a river's ecosystem.

3. *Recognition at policy and programme levels of the multiple roles institutions play and the combined importance of civil society, governmental, media and other organisations.* Adaptive processes and the resilient nature of livelihoods are, to a certain extent, enabled by the presence of diverse forms of institutions. Unless the markets, private companies, government organisations, the media, NGOs and CBOs are present, development processes tend to be skewed. Creating environments where all levels of institutions are present and able to counterbalance the perspectives and /incentives of each other is, we believe, central to both development and disaster mitigation. This closely follows the observations of Amartya Sen and others on the links among social processes, development and disaster mitigation.<sup>4</sup>

**Investment in supporting the development of multipurpose and flexible physical, institutional and communication infrastructure is central to both development and disaster mitigation.**

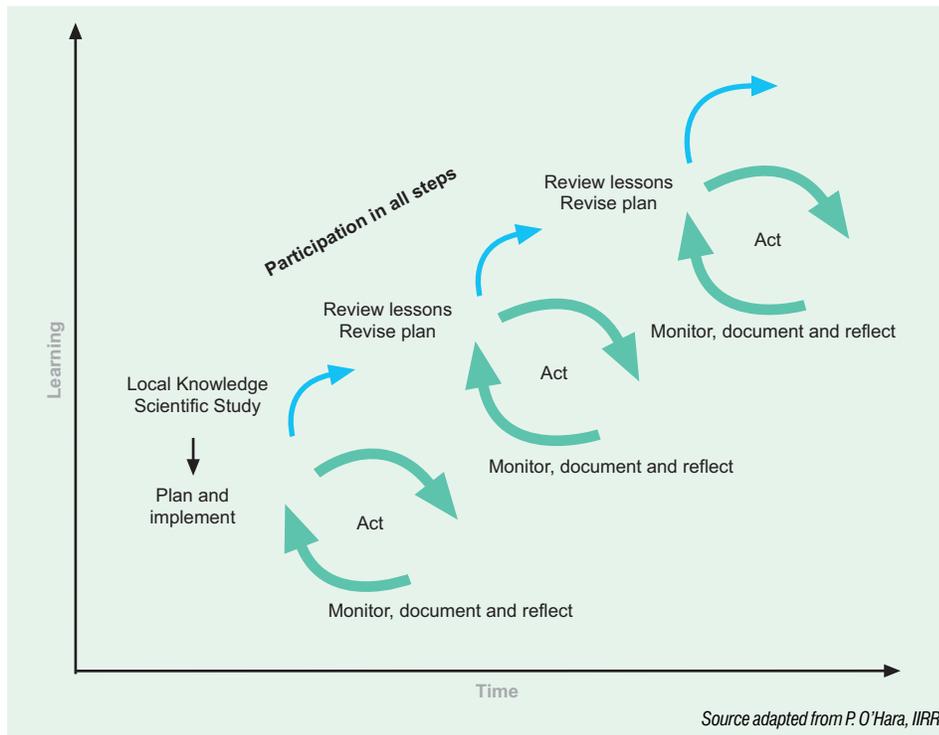
The above elements imply, in immediately tangible terms, that investment in supporting the development of multipurpose and flexible physical, institutional and communication infrastructure is central to both development and disaster mitigation. This infrastructure, which ensures the presence of multiple organisations with multiple perspectives that are able to communicate through the media and markets is a key factor that we believe will catalyse and underpin social processes for adaptation and disaster mitigation.

### **Pilot Activities that Test Implementation Approaches and Promote Learning**

Theory and observations are fine; translating them into practice and determining the degree to which they actually enable adaptation to climatic variability, however, requires action on the ground. We believe that a learning process which would involve the selection of specific locations where floods and droughts are major features affecting livelihoods is required. In these locations, work needs to be undertaken at multiple levels – with communities as well as with regional organisations – to identify systemic factors that constrain the ability of local communities, and, in particular vulnerable populations, to adapt. This would lead to the identification of strategic actions – whether through the formation of local SHGs, the provision of education, the building of flood-adapted infrastructure or changes in government policy – that increase adaptive capacity. These actions should then be implemented where possible and their results in terms of livelihood resilience evaluated. The overall goal would be to create a learning process modeled on Figure 33.

As discussed in the case of drought relief in India, watershed programmes which involve communities, NGOs and the government may represent a starting point for livelihood-focused implementation activities in drought prone areas. While these do not address many of the key dimensions related to adaptive capacity, such as education, migration and the role of markets, they do begin to address many of the

Figure 33: **Learning by Doing, A Learning Process Approach**



components related to adaptation within communities and, as a result, could serve as a starting point. No equivalent programme exists in flood-prone regions. This gap needs filling.

### Build a Scientific Understanding of the Natural and Social Processes

Translating concepts into practice cannot be done in one step. The current study provides a set of initial observations. The emphasis, here must be on the adjective ‘initial.’ We have not studied adaptive processes in detail

across a range of contexts nor have we considered many other natural and social factors that contribute to vulnerability. The interaction of natural and social factors and the degree to which specific aspects, such as diversification, mobility and social position, actually contribute to or reduce vulnerability remain poorly understood. For this reason, basic research on the natural and social processes affecting adaptive capacity must continue; it is an essential input for ensuring informed practice.

**The interaction of natural and social factors and the degree to which specific aspects, such as diversification, mobility and social position, actually contribute to or reduce vulnerability remain poorly understood.**

## KEY ISSUE AREAS

Beyond the need for basic research that will contribute to shaping effective implementation strategies, the case studies and conceptual research undertaken on adaptive strategies raise a number of issues that are central to development policies and relations between regions. These issues have to do with migration and increasing rural-urban interlinkages, cross border flows of goods, information and services, and basic humanitarian concerns. Each of these issues is central to many of the macro-tensions facing global society and approaches to reducing poverty and responding to climatic variability and change. As a result, they require substantive research and policy analysis.

### Migration and Urban-Rural Interlinkages

Our research indicates that migration and the remittance income flows it can generate should often be seen as a key strategy enabling people to both cope with and adapt to floods, droughts and the consequences of long-term change in water resources rather than as a negative consequence of environmental degradation. As Adger *et al.* comment, ‘Migration, particularly domestic migration, is an important component of demographic transition often overlooked in population-environment debates.’<sup>5</sup> They also point out that: ‘In general terms, remittance income can improve social resilience to the extent that it promotes diversification and risk spreading, enhances social capital and extends opportunities for improving

wellbeing, although negative effects on resilience may also occur.’<sup>6</sup> Their view and our own evidence from the case studies suggests that migration, whether long- or short-term, should be viewed as a central and often positive strategy households use to adapt livelihoods as conditions change.

This change of perspective has major implications not only for disaster relief policies but also for policies affecting investment in and regulation of urban development. Inter-regional migration, urban-rural migration, and commuting are all different dimensions of the strategies households adopt to obtain access to non-agricultural sources of income when agricultural livelihoods are threatened. Whether or not the immediate cause of migration is related to specific drought or flood events, migration often serves to mitigate the impact of climatic variability. Dryland agriculture, one of the major focal points for agricultural development in India, may actually *depend* on the ability of populations to migrate or draw on outside income sources when droughts or other problems occur. As with the migratory pastoralists of Africa, it is impossible to take full advantage of ephemeral resources unless livelihoods have the ability to move when such resources become unavailable.

It is important to emphasise that we recognise the complex implications of migration for society. Urban areas and urban services in South Asia are

It is important to emphasise that we recognise the complex implications of migration for society.

straining under the weight of massive populations. Actively encouraging permanent migration and growth in already stressed urban areas is not an attractive option. This said, migration is occurring and the factors creating incentives for it are not easy to control. Furthermore, migration and commuting are central to the development of diversified, resilient livelihood systems. Equally importantly, migration is not a one-way street. In many drought- and flood-affected areas, urban migrants are the source of remittance income streams that support rural populations in times of crisis. Without access to urban jobs and income streams, migration out of rural areas during disasters would, almost certainly, increase.

Overall, the increasing interlinkage between urban and rural populations and between migrant and place-based livelihoods suggests the importance of further substantive work on migration. Actions that increase the ability of populations to commute – to obtain access to non-farm urban economic systems while remaining in or near their existing homes – may prove critical in balancing the push and pull factors driving large-scale migration and urbanisation. This, it seems to us, is one of the most crucial areas for future investigation and is central to the ability of populations to adapt to climatic variability and processes of change.

### Understanding Cross-border Flows

The importance of migration, the flow of people between areas, to adaptive capacity is paralleled by other key flow

processes. Financial flows involving credit, remittances and investment are central to diversifying the economic opportunities available within areas. Information flows – whether they involve climate related hydrometeorological information or market news – are equally important. Farmers who know global commodity prices are in a far better position to negotiate reasonable returns for their crops and thus accumulate savings to tide them over during drought or flood events than farmers are who are at the mercy of local market makers. Economic flows are critical too. Having access to markets for products heavily influences the degree to which economic diversification is possible. Similarly, the ability to purchase goods, such as food, fodder and water, on the market often determines the ability to survive during droughts or floods. Avoiding involuntary displacement requires having mechanisms through which populations can meet their basic needs by drawing on resources imported from outside drought- and-flood-affected areas.

Overall, the ability of local populations to adapt to droughts, floods and climatic variability depends heavily on the degree to which goods, services and information can flow across local and national borders. Such flows will become a critical area for policy research both within countries and at the global level as climate change increases the importance of adaptation and adaptive capacity.

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**Theory and observations are fine; translating them into practice and determining the degree to which they actually enable adaptation to climatic variability, however, requires action on the ground.**

### Documenting Adaptive Capacity and the Changing Nature of Vulnerability

As noted earlier in the section on translating concepts into practice, increasing our basic understanding of the factors contributing to adaptive capacity and the causes of differential vulnerability is a critical area for further research.

At present there is little information available to actors and decision-makers on either the changing dimensions of vulnerability or the effectiveness of systemic approaches to vulnerability reduction. Sources of vulnerability themselves are often unclear and, due to the multiple factors involved, their identification requires insights that cross disciplines.<sup>7</sup> Most disaster relief assumes that the poor and the landless are the most vulnerable. As the case of Satlasana illustrates, however, much depends on specific livelihood characteristics. The poor, who often have more experience with labour markets may, in some cases, be less vulnerable than other populations which are less experienced and lack the skills required for changing livelihoods. Overall there is a need for better understanding of the factors enabling adaptation (what really makes some groups good adaptors and others poor adaptors?). This is closely related to questions of differential vulnerability and the limitations key groups, such as women, face with regard to opportunities for adaptation. Issues related to the needs of women are particularly important to integrate into disaster mitigation and development

processes – a fact widely noted by others.<sup>8</sup>

Key questions related to the roles of different institutions must also be addressed. We have highlighted the role SHGs appear to play in reducing vulnerability - but long-term insights on their viability and the success they will actually achieve are lacking. Similarly, we have emphasised the importance of institutions and systems that serve multiple functions. Schools that also serve as flood refuge, flood warning systems that operate using telephone networks, each of these is an example of an intervention that we believe remains alive and functional in the context of droughts and floods *because they are used during normal times as well as periods of crisis*. Multiple functions and regular use appear central to the development of responses to climatic variability that are robust under a range of conditions. How this can be achieved and, equally importantly, the degree to which disaster mitigation objectives will actually be met are uncertain, however.

### Humanitarian Issue Areas

A final point to emphasise is the need for substantive work documenting the link between basic humanitarian issues and the changing dimensions of vulnerability associated with floods and droughts. Potential links with human trafficking and female infanticide have been noted earlier in the report. Such issues demand further investigation but they are far from the only fundamental humanitarian issues associated with the

At present there is little information available to actors and decision-makers on either the changing dimensions of vulnerability or the effectiveness of systemic approaches to vulnerability reduction.

need for human populations to adapt to current and changing patterns of climatic variability.

If global climatic change occurs abruptly, as some predict it may, the importance of migration and local-to-global flows of information, finances, goods and services to local adaptive capacity - and indeed to the survival of

local populations - may well raise central humanitarian issues at the global and national levels to levels that extend well beyond the provision of relief. How such issues are addressed may, in many cases, depend on global perspectives toward migration and on the array of global institutions that moderate trade, information and financial flows.

## End Notes

<sup>1</sup> Pantoja (2002)

<sup>2</sup> Moench, Lackner *et al.* (1997)

<sup>3</sup> Setchell (2001)

<sup>4</sup> Dreze, Sen *et al.* (1995); Sen (1999); Sen (1999)

<sup>5</sup> Adger, Kelly *et al.* (2002)

<sup>6</sup> *Ibid.*

<sup>7</sup> Alwang, Siegel *et al.* (2001)

<sup>8</sup> Wiest, Mocellin *et al.* (1994); Enarson and Morrow (1998); Morrow (1999); Ariyabandu (2000); Enarson (2000); Enarson (2001); Enarson and Fordham (2001); Kumar-Range (2001)



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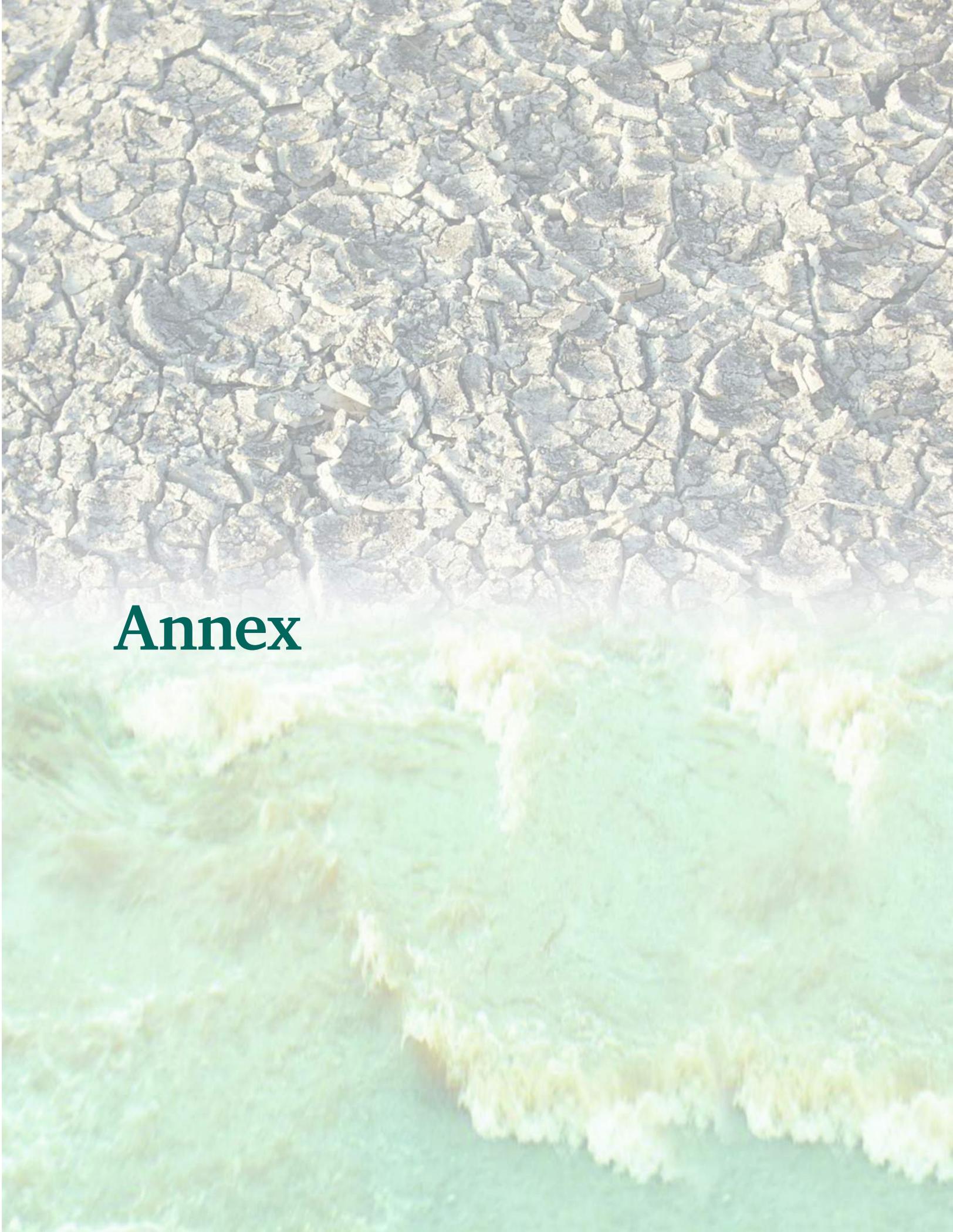
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# **Annex**

## I: CLIMATE CHANGE IN SOUTH ASIA

The impacts of climate changes on floods and droughts will further increase the vulnerability of rural South Asian populations, which are already plagued by extremes of nature. Despite the repeated occurrence of these natural disasters, almost on an annual basis, an adequate framework for preventive measures is lacking, and efforts to counter these events are mostly reactive. Efforts in creating mechanisms to reduce the vulnerability of people to floods and droughts could be used as a 'points of entry' to address climatic changes and their impacts on recurring extreme events. Since a modicum of climatic change in the form of global warming has already been created by human actions, incorporating the likely outcome into an existing process of addressing vulnerabilities would reduce the costs of adapting to climate changes. To this end it is necessary to understand three aspects of the impacts of climate change on people: (i) the linkages between climate change and extreme events (floods and droughts), (ii) the systemic factors that cause changes in extreme events due to climate change, and (iii) the increase in vulnerability attributable to the impacts of climate change on extreme events. This annex presents the summary of anticipated climatic changes in South Asia and their possible implications for floods and droughts.

### Anticipated Climatic Changes in South Asia

South Asia with its huge and growing population of over one billion people, long densely-populated and low-lying coastline, and an economy that is closely tied to its natural resource base is vulnerable to the impacts of climate change. This is also true of India where the high dependence on natural resources and low available capital exposes the country to climatic risks (see, for example, Rosenzweig and Parry, 1994).

There are already indications that global warming is occurring on the Indian subcontinent (Rupakumar *et al.*, 1994; Schaefer 2001). These studies show that an average temperature increasing approximately 0.5°C annually with greater increases during the winter (1.13°C) and the post-monsoon period (0.89°C) is likely. Future projections indicate that global warming will be significant; For example, Loneragan (1998) predicts average temperature changes in the range of 2.33°C to 4.78°C if CO<sub>2</sub> concentrations double; Lal *et al.* (1995) predict that the annual mean maximum and minimum surface air temperatures will increase by 0.7°C and 1.0°C respectively from the 1980s to the 2040s.

The climate change predicted in the Third Assessment Report of the Interdisciplinary Panel on Climate Change (IPCC, 2001) is given in Table 1. In general, the projected warming over Asia is higher during the winter than during the summer for all time periods (Giorgi and Francisco, 2000).

Table 1: Predicted Climatic Changes in South Asia

Parameters	2020s			2050s			2080s		
	Annual	Winter	Summer	Annual	Winter	Summer	Annual	Winter	Summer
Temperature changes (°C)	1.36	1.62	1.13	2.69	3.25	2.19	3.84	4.52	3.20
Effect of aerosols	(1.06)	(1.19)	(0.97)	(1.92)	(2.08)	(1.81)	(2.98)	(3.25)	(2.67)
	Annual	Winter	Summer	Annual	Winter	Summer	Annual	Winter	Summer
Precipitation change (%)	2.9	2.7	2.5	6.8	-2.1	6.6	11.0	5.3	7.9
Effect of aerosols	(1.0)	(-10.1)	(2.8)	(-2.4)	(-14.8)	(0.1)	(-0.1)	(-11.2)	(2.5)

Numbers in parentheses are area-averaged changes when direct effects of sulfate aerosols are included.

The prediction made by Lal *et al.* (2001) using Regional Global Circulation Models (GCMs) for India-specific predictions are given in Table 2. The spatial pattern of temperature change is largely season-dependent. The spatial distribution of annual mean surface warming suggests that north India may experience an annual surface warming of 3°C or more, while over much of the southern peninsula the warming is predicted to be less than 2°C during winter and less than 1.5°C during the monsoon.

There is no consensus on how global warming will affect pattern of monsoon rainfall. A number of studies using GCM models show that rainfall intensity may increase, while other studies show a decline in precipitation (Stephenson *et al.*, 2000). The monsoon is driven by land-sea temperature differential. It is projected that climate change would result in this differential in which case Lal *et al.* (1995) suggest that there will be a decline in rainfall. Other studies, however, predict that the difference between land and ocean surface temperatures will increase and therefore rainfall will also increase (Chase *et al.*, 2000). None of these studies consider the impact of aerosols, which reduce temperature increases over land and, in consequence, the land-sea contrast. The presence of Sulfate aerosols, however, will have a stronger impact on reducing the summer monsoon precipitation than will greenhouse gases alone (Lal *et al.*, 1995; Mitchell *et al.*, 1995; Cubasch *et al.*, 1996; Roeckner *et al.*, 1999). The overall effect is, at least, partly dependent on the land-sea distribution of aerosols and on whether its indirect effects are included along with direct effects.

Historical analyses of climate show either no trend (Kothyari and Singh, 1996; Schaefer, 2001) or attribute declines in monsoon rainfall to increases in temperature (Chase *et al.*, 2000). Such analyses also show that trends vary: there are more droughts in the northwestern part of the country and fewer in the eastern, northeastern, southern, and central parts of India.

Simulations using model analyses predict an enhanced hydrological cycle and an increase in mean annual rainfall over most of Asia (Giorgi and Francisco, 2000),

though there is a large degree of variation in these predictions. The mean annual increase in precipitation averaged over an area is projected to be  $3 \pm 1\%$  in the 2020s,  $7 \pm 2\%$  in the 2050s, and  $11 \pm 3\%$  in the 2080s (Table 2). Lal *et al.* (2001) predict that India may experience an increase of about 7 to 10% area-averaged mean annual precipitation for temperature changes ranging from 3.5°C to 5.5°C during the 2080s. Their projections also indicate that winter rainfall will decline between 5% and 25% and summer monsoon rainfall increase between 10% and 15%. The decline in winter rainfall over India is likely to be significant and may lead to droughts during the dry summer months. The study also suggests that changes in the spatial patterns of precipitation will be significant. During the monsoon season, the results suggest an increase of 30% or more in precipitation over northwestern India by 2050. The western semi-arid regions of India could also receive higher than normal rainfall in a warmer atmosphere. The model also predicts an increase in the probability of extreme rainfall events; it suggests that ‘increased precipitation intensity, particularly during the summer monsoon, could increase floods.’

The results of a study on changes in soil moisture broadly follow those of precipitation studies, except in eastern India, where soil moisture is likely to decrease as a result of enhanced drainage.

Table 2: Predicted Temperature Changes by Season

Year	Season	Increase in Temperature (oC)	
		Lowest	Highest
2020s	Rabi	1.08	1.54
	Kharif	0.87	1.12
2050s	Rabi	2.54	3.18
	Kharif	1.81	2.37
2080s	Rabi	4.14	6.31
	Kharif	2.91	4.62

Source: Lal *et al.* (2001)

Table 3: Precipitation change predictions for India

Year	Season	Change in Rainfall (%)	
		Lowest	Highest
2020s	Rabi	-1.95	4.36
	Kharif	1.81	5.10
2050s	Rabi	-9.22	3.82
	Kharif	7.18	10.52
2080s	Rabi	-24.83	-4.50
	Kharif	10.10	15.18

Source: Lal *et al.* (2001)

Climate change is likely to result in greater inter-annual variability of daily precipitation (Kitoh *et al.*, 1997; Lal *et al.*, 2001; Kattenberg *et al.*, 1996). Lal *et al.* (2000) report that the variability in intra-seasonal precipitation will also increase. The intensity of extreme rainfall events is projected to be higher in a warmer atmosphere, suggesting a higher frequency of extreme precipitation events, which, in turn, will increase the possibility of more frequent flash floods in parts of India, Nepal and Bangladesh.

In summary, predictions of changes in the climate indicate that there will be a significant increase in temperatures. These changes are predicted to be greater during the winters in the northern and eastern parts of the

country. There is, however, there is no consensus among predictions regarding precipitation over India. Since the predictions of most GCM-based vary considerably we can have little confidence in them. The study of Lal *et al.* (2001), which is the most comprehensive to date, makes the following predictions: (i) an increase in rainfall over northwestern regions and a decline over eastern and southern regions; (ii) an increase in summer rainfall and a decline in winter rainfall; (iii) a greater probability of extreme rainfall events. Because much of tropical Asia is intrinsically linked with the annual monsoon cycle, a better understanding of the future behaviour of the monsoon and its variability is warranted for economic planning, disaster mitigation and the development of adaptive strategies to cope with climate variability and change.

## Floods and Droughts

Floods and droughts are major recurring natural disasters in India. On average, annual flooding covers about 40 million hectares (Mirza and Ericksen, 1996). The western parts of Rajasthan and the Kutch region of Gujarat are chronically drought-affected areas. Drought conditions have also been reported in Bihar and Orissa states, too. The interplay of temperature, precipitation and global warming could either aggravate or temper floods and droughts in India.

### Droughts

The impact of climate change on droughts is due to the combined effect of two factors: changes in temperature and changes in precipitation both in terms of quantity and spatial and temporal distribution. Apart from climatic factors, changes in the demand for water attributable to activities are also relevant. A temperature increase will increase evaporation (Chattopadhyaya and Hulme, 1997), especially in arid and semi-arid regions of North India, and thereby, increase vulnerability to droughts. Another aspect relevant to semi-arid and arid regions is the predicted decline in winter rainfall. This decline could result in seasonal droughts by affecting the availability of water for crop production during *rabi*. A decline in winter rainfall coupled with the failure of summer monsoon rains would be likely to increase the intensity of droughts.

These climatic changes need to be studied in conjunction with changes brought about by development, especially those related to groundwater use in drought-prone areas. A study of the Kutch region conducted by the National Communication Project highlights the dangers of significant climate change. The region is very prone to droughts: they occur every two to three years. Groundwater is the main source of water, but seasonal streams and medium and minor irrigation schemes established by the government to serve 15% of the cultivable land are also relied upon. Over-dependence on groundwater and increasing consumptive use (a 50% increase was registered in the period from 1991 to 2001) has resulted in a fall in groundwater levels. Most of the sub-districts in the region are either exploiting more than or a substantial part of the groundwater recharge.

Greater temperatures will increase evaporation, resulting in lower recharge of aquifers from rainfall. In addition, an increase in future consumptive use of between 150% and 200% more than the available recharge is expected. Any decline in rainfall is therefore likely to increase the likelihood of droughts as well as the ingress of saline water in the coastal region.

In the last few decades, the decline in surface water has increased dependence on groundwater: 37% of the annual replenishment of groundwater is extracted. Groundwater supports bulk of agriculture production and also meets 85% of rural people's drinking water requirements and more than 50% of urban and industrial water demand. Some states including Gujarat, Haryana, Punjab, Rajasthan and Tamil Nadu already face falling water tables in some or all of their areas. Some of these areas are grain belts for the country. The National Commission on Integrated Water Resource Development has assessed that water demand will increase from approximately 600 billion cubic metres (BCM) to 824 BCM in 2025 and further to 1,180 BCM in 2050. Any decline in precipitation in these states will aggravate the drought situation as water tables fall below economically acceptable levels of exploitation.

Droughts could also cause areas which are not drought-prone to become so due to changes in stream flow patterns. Apart from changes in precipitation, the most significant factor in inducing changes would be increased demand for irrigation as a result of climate change. Boland (1997) predicts that increases in water demand related to climate change will range from 8% to 19%. The Döll and Siebert (1999) study shows that there will be a net increase in irrigation requirements for most irrigated areas in India. Alcamo *et al.* (2003) predict that in water availability in the rivers of Ganga basin region would increase by 25% to 50%. This increase is likely to be even greater in northwestern parts of India. The only region with a very slight negative or positive change is southern India.

### Floods

Climate change will influence stream flow patterns through: (i) changes in the precipitation, (ii) changes in volume and timing of snow melt from glaciers, and (iii) changes in the type of precipitation – snow or rain – in the Himalayan region. The perennial rivers originating in the high Himalaya receive their water from snow and glaciers. Snow's contribution to the runoff into major rivers is about 10% in the eastern Himalaya (Sharma, 1997) but more than 60% in the western Himalaya (Vohra, 1981). A significant proportion of dry season runoff is derived from snow (Singh *et al.*, 1997). The warming trend of the last fifty years has resulted in greater rates of snowmelt than of snow accumulation. The Gangotri glacier, for example, is retreating by about 30 metres a year. The mean equilibrium-line altitude, where snow accumulation is equal to snow ablation, has risen by 50 to 80 metres (Pender, 1995). Glaciers are also retreating in Nepal

Himalaya. Melting glaciers result in increased water flows in the initial years followed by a decline in flow as the ice resources decline. Simulation studies indicate that by the year 2050, the average annual runoff in the Brahmaputra River will decline by 14% (IPCC, 2001).

The effect of increased snowmelt on floods will depend on the timing of the melt vis-à-vis the monsoon. If the pattern of snowmelt in the high Himalaya coincides with the summer monsoon season, initial years will see an increase in flood events and disasters due to high runoff. Intensified rainfall, as is predicted for northern regions, is likely to aggravate the situation. Such impacts will be observed more in the western than in the eastern Himalaya because of the higher contribution of snowmelt to runoff in the west (Sharma, 1997). Increased warming is also likely to change the type of winter precipitation from snow to rainfall. This will affect stream flow patterns but is unlikely to affect floods.

Mirza *et al.* (1998) investigated the effects of changes in precipitation resulting from global warming on future flooding in Bangladesh. They used standardised precipitation change scenarios from four GCMs. The most extreme scenario showed that for a 2°C rise in mean global temperatures, the average flood discharge for the Ganga, Brahmaputra and Meghna rivers could increase as much as 15%, 6% and 19%, respectively.

Apart from changes in snowmelt and precipitation in the Himalaya, changes in the pattern, intensity and frequency of rainfall will have significant impacts on floods. Lal *et al.* (2001) have indicated that climatic changes could result in more frequent high-intensity rainfall events. Global climate models, at present, cannot simulate with accuracy the likely pattern of short-duration, high-intensity, localised rainfall, which are necessary for analyses of flood events. A study based on a combination of changes in mean precipitation (due to climate change) and in the coefficient of variation in runoff shows that western India may experience very high river discharges more frequently than it does at present (Alcamo *et al.*, 2003).

## Conclusions

The climatic changes predicted in South Asia are likely to exacerbate both droughts and floods. The increased evaporation demand due to temperature increases coupled with a decline in precipitation in semi-arid and arid regions is likely to increase the frequency of droughts. Elsewhere, changes in stream flow due to increased snowmelt and changes in the form and pattern of precipitation in mountain regions could affect both floods and droughts. On the one hand, more summer snowmelt combined with increased precipitation is likely to increase the intensity and number of flood events; on the other, the resulting decline in snow storage will affect water availability during the dry season.

Because changes in rainfall pattern and intensity have not yet been adequately analysed, there are large gaps in our understanding of the effects of climate change on droughts and floods. Furthermore, the effects of climate change on agriculture (and on water demand in particular) and on forests need to be investigated in order to improve our understanding of the impacts of climate change. Forest dynamics have not been studied. Changes in forest cover and their types also impact groundwater recharge. To that end there is a need for an integrated study to thread together these common factors for better understanding of the overall impacts of climate change on flood and droughts.

The above review reflects differences in interpretation about impacts of climate change even among those who have pursued this agenda. Given this context rife with uncertainty, what would be the policy response and how should that be formed and by whom. These questions have been extensively discussed in *Human Choice and Climate Change* and encapsulating its insight is relevant for south Asia. Rayner and Malone (1998) suggests 'shifting the balance of climate change policies from optimizing approaches to mitigation towards building resilience and flexibility into societies... that attention should be paid to understanding vulnerability, especially among the poor and already vulnerable' and have 'stressed a participatory approach in which decision emanate from as low down the political hierarchy and possible.'

The approach, according to Rayner and Malone (1998), 'is not to commit oneself to one of these viewpoints which is to gamble that it will turn out to be right and others wrong. It is far more likely to that it will be partly right and all will be partly wrong. Recognising this and stewardship the kind of institutional pluralism necessary to maintain multiple viewpoints and a rich repertoire of policy strategies from which to chose is what promoting societal resilience, sustainable development, climate change governance is ask about.'

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## II: SPECIFIC IMPLICATIONS FOR DISASTER MITIGATION AND RELIEF PROGRAMMES

A core implication of the research contained in this report is that the mechanisms for effective disaster mitigation are tightly intertwined with the mechanisms for development. Their interrelationship does not, however, imply that development and disaster mitigation are the same thing. Instead, it suggests that organisations concerned with disaster mitigation need to look for ‘points of entry’ where inputs targeted at broad development processes can make specific contributions to drought- and flood-resilience. This insight is not new. Earthquake mitigation, for example, commonly focuses on actions such as improving building codes, which, in turn, shape the environment built over long periods of time. Similarly, flood plain zoning is commonly discussed (though far less commonly implemented) as a long-term solution to flooding.

With above clarification in mind, we reiterate that targeted disaster mitigation as part of long-term development processes can make important contribution. This report suggests a number of areas in addition to conventional mitigation activities where targeted inputs and vulnerability analysis could contribute substantially to making flood- and drought-resilience a part of ongoing development processes. Numerous examples have already been discussed in the main body of the report. To summarise, the key points of leverage include the following:

1. An analysis of the vulnerability of transportation, communication, economic and water supply systems can identify design changes that will increase their resilience and ensure smooth operation in the context of floods and droughts;
2. Drought- and flood-resilient infrastructure in the forms of housing, for example, that serves as a platform for diverse livelihood activities and asset protection should be developed and promoted in vulnerable areas;
3. Institutional or physical systems that support beneficial forms of migration when it needs to occur should be developed. The possibilities are :
  - a. developing credit facilities migrants can access to meet consumption, travel and other needs while searching for work;
  - b. exploring the establishment of support services (education, health, banking, etc.) that match the transient state of migrants;
  - c. evaluating the need for physical infrastructure (like housing) in urbanising locations where temporary or permanent migrants are likely to move to in search of employment.

4. Supporting development of social infrastructure, such as self-help groups, that enhances resilience, particularly among vulnerable groups, in flood- and drought-vulnerable regions.

Where flood- and drought-relief measures are concerned, perhaps the single most important direct implication of our research is that attempts to restore conditions to the *status quo ante* are, in many cases, likely to be inappropriate. Instead, floods and droughts need to be viewed as periods during which transformative changes in livelihood systems can occur and offer opportunities for supporting change processes during disaster relief. It is important to recognise that changes do not have to be dramatic. Relatively minor infrastructure interventions (such as rebuilding houses so that they have flat roofs in flood-prone areas) are a clear shift from the *status quo ante* and change livelihood resilience in a fundamental way, but they are a far cry from attempts to re-engineer society, something we emphatically are not recommending. Instead, even in the case of providing support to migrants, the approach we recommend generally involves small strategic forms of relief that help people do what they are already attempting to do in response to a flood- or drought-event.

### III: SMALL GROUP DISCUSSIONS AT THE DIALOGUE ON ADAPTATION, NEW DELHI

This annex summarises the insights and issues discussed in four small group sessions at the Roundtable Dialogue on Adaptation to Floods and Drought, New Delhi, 6-7 June 2004. The small group sessions focused on *Adaptation and Livelihood Resilience in relation to: Governance Systems; Vulnerability and Humanitarian Concerns; Social and physical infrastructure; and Economic and Social Inter-linkages*. Each discussion was intended to address questions related to: (1) critical areas for research to address knowledge gaps; (2) points of entry for effective intervention and action; and (3) potential next steps. Insights generated in each of the small group sessions are summarized below.

#### Adaptation and Governance

Participants in the small group session on Adaptation and Governance focused first on clarifying the conceptual foundations on which their discussion would be based. According to them, adaptation can be seen as decision-making by different units within resilient systems. Coping, in contrast, occurs when resilience has been lost. The notion of adaptation is important given the decision-making uncertainties facing social units at geographic scales from the extremely local to the global. These uncertainties are high enough in normal times and become extreme during periods of high stress such as floods and droughts. During extreme events the behaviour of the overall system in which livelihoods are embedded – a composite of both natural and human-built sub-systems – is highly complex and, at best, only partially understood. Furthermore, the nature of such understanding, whether in modern scientific or other terms, varies not only across the geographic-technical continuum from villages to international scientific groups but also across different social solidarities at all levels. This diversity in understanding is not, primarily, related to scientific or technical communication gaps but comes about because different social solidarities perceive the risk to them from disasters very differently.

Risk perception at different scales guides decision-making by the array of social solidarities (each of which has its own accompanying style of management) that make up a 'governance environment.' Social activists often highlight risks with the objective of sensitising villagers and politicians concerning looming dangers. The management style they generally advocate is egalitarian, group-based risk minimisation. In contrast, individualists and private sector organisations in the market realm are often risk-takers who view disasters as opportunities and seek to profit from them. Their management style focuses on flexibility and individualistic response strategies. Governments and their agencies generally try to manage risk and strive to strike a balance between threat and opportunity. Regulatory management styles implemented by hierarchically structured organisations tend to be the response strategy they advocate. In most situations, all three of these

solidarities exist and the often tense interplay between them creates the governance environment – that is to say, the environment defining what courses of action ‘society’ at different levels is willing to consider and implement.

Within the dynamic governance environments created by the competing world views of different social solidarities, small group discussants emphasised that questions of risk resilience have to capture the attention of decision-makers. That is to say, greater attention needs to be paid to the kinds of intervention that will enhance the resilience of those affected by disasters and allow them to bounce back and to what types of intervention deplete resilience and undermine longer-term sustainability. It is within this frame that the question of ‘why adaptation?’ has to be answered.

When the stress associated with extreme events, such as floods and droughts, is approached from the perspective of risk resilience, numerous important questions arise. Many of these are questions of governance. Take the case of technological choice. Technology choices that influence risk are made by a broad mix of community, private sector and governmental actors in ways that reflect their perceptions regarding threats and opportunities. Decision-making, in this situation, is a core governance function but one that is not being exercised by governments alone. Numerous social units at different levels (village councils, extended families and kinship arrangements) and social solidarities (environmental or social activists and market players) practice decision-making – and hence governance – with fundamentally different ideas about what is to be governed and how. A hierarchic department may prefer a long embankment for protecting villages from floods, but to an entrepreneurial villager with the requisite wherewithal, flood security may mean building a house with a flat (concrete) roof or a house on stilts. To a set of villagers organised along egalitarian lines it may mean collectively raising the plinth level of the village. The choice of technology is a socially constructed decision that is reflective of the perceptions of risk resilience by the social solidarity making that decision.

When technologies are planned and implemented from above they rarely function as intended and even more rarely do the ultimate end users put them to the use they were originally designed for. Embankments for flood protection are a classic example. By blocking drainage, they often lead to water-logging on the ‘protected’ side. As a consequence, during floods both sides of the embankments are often under water. When this happens, villagers put the embankment technology to use by climbing onto it with all their belongings, in effect converting the embankment to a plinth-raised village. The lesson from this and many other examples is that flood- and drought-protection technologies have to be embedded within the social system they intend to serve. If a building is designated as a dedicated flood- or earthquake-proof shelter, when the event does occur, dedicated structures are often

run-down or unusable for a variety of reasons. If, however, the structure doubles as the village school in ‘normal times’, it is there ready to be used during emergencies. The same principle applies to dedicated flood warning systems. Lack of regular (daily) use leads to lack of maintenance and lack of maintenance makes the system non-functional when required. If, however, warning systems are embedded within communication systems that are operated on a regular basis, such as local radio stations, they are far more likely to be available and effective during the disasters.

This begins to answer the question ‘why adaptation?’ and relate it to the governance environment. An adaptive approach implies that, when disaster mitigating technologies are chosen by external support organisations, attention needs to focus on the degree of social and technical inflexibility/flexibility inherent in the technology and how that relates to the regional governance environment. The technology needs to respond to the governance environment in a location and to reflect the motivations and perspectives of the social solidarities comprising that governance environment. It needs to be something that will be used and maintained by the groups on the ground. Furthermore, because local contexts are inherently dynamic and, as previously emphasised, subject to substantial uncertainty, attempts to comprehensively assess mitigation needs are likely to be ineffective. Instead, approaches need to focus on the inherent adaptability and robustness of institutional and other technologies. Thompson (1994) suggested that key technical indicators of inflexibility include: large scales, long lead-times, capital intensity and the requirement for major infrastructure early on. Corresponding organisational indicators of inflexibility are: single mission outfits, closure to criticism, hype and hubris. In sum, rather than attempts toward comprehensive risk assessment and the development of large-scale integrated mitigation strategies, more piece-meal approaches that involve smaller interventions which complement existing, ‘alive’ institutions within a local governance environment are likely to be more effective at enhancing resilience.

This point is especially important during times of social conflict when stresses are often synergistically compounded. Whether conflicts are exacerbated or ameliorated by a technological choice often depends on the nature of the planning and design decisions as well as the process of implementation. Often resilience-enhancing technologies emerge through local decision-making systems that are attuned to local capabilities. In Nepal’s case, for example, many development programs that have strong roots in local communities (including this survey) have not been affected by the ongoing Maoist insurgency while others, particularly large-scale, externally implemented projects, have. Similar processes affect flood control measures in the northern Ganga plains. There, local residents often breach embankments built without their consent or participation while, at the same time, taking other more localised steps to reduce flood impacts.

As indicated earlier, if one defines policy as the environment that shapes action, policy decisions are, in effect, taken as much by market actors, egalitarian groups and social auditors as they are by government departments. Furthermore, the policy decisions taken by different sets of actors often are not congruent. Even the ‘fatalist masses’ have their policy of withholding consent, as the 2004 Indian elections have shown. As regards floods, a government department may have a policy of restoring the *status quo ante*, while that of the market may be to take advantage of the situation. Different from both are the social auditors who want to see how proposed activities suggested by the two solidarities stand against concepts of equity and social justice. This sub-theme can be taken as the theoretical context of for the next two sub-themes of vulnerability and infrastructure.

### Understanding Vulnerability

Within the above context, the small group session on vulnerability took a fresh look at how the term ‘vulnerability’ is used as an umbrella concept for factors that cause the human losses related to physical hazards such as floods and droughts. The concept of vulnerability draws attention to the impacts of drought and flood on certain groups, certain institutions and certain places. It emphasises the degree to which the risks associated with floods and droughts can be ameliorated by adaptive actions that already are or can be brought within the reach of the population at risk. Vulnerability is closely associated with socio-economic differentiation but no standard framework exists for identifying different sources. Furthermore, the processes creating and reducing vulnerability are dynamic and heavily influenced by differences in gender, health, education and ethnicity. This dynamism and diversity necessitates nuanced understanding in order to both identify the specific sources of vulnerability and the points of leverage where change can be effected. The small group session emphasised the need to improve understanding of the mosaic of vulnerability at various scales and help formulate locally-based indicators. This is fundamentally different from the broad pronouncements associating vulnerability with defined social groups (the poor, women, racial minorities, etc...) which policymakers in government seem to prefer. As surveys conducted for the Adaptive Strategies Project indicated, for example, the poor are not always the most vulnerable. In fact, during droughts they may be less vulnerable than larger farmers due their diversified livelihoods based on agriculture, non-farm activities and migration remittances. Such sources, meagre though they may be, can be more reliable during periods of drought than the intensive groundwater-based agricultural livelihood systems on which large farmers rely. When groundwater resources fail, medium farmers can be hit the hardest and have nothing to fall back on.

Improved understanding of vulnerability must therefore be based on the recognition that there is differential access to resources which does not always follow widely-recognised wealth, gender, ethnicity or other divides in society. Conveying concepts

of differential vulnerability to decision-makers in the government and elsewhere is essential. This requires understanding the linkages between governments, end users and other actors. This may be best achieved by empirical studies that document specific cases of differential vulnerability along with the array of strategies that strengthen livelihoods and build adaptive capacities to floods and droughts. The small group felt there was a great need to extend analysis and inquiry regarding the differential dimensions of vulnerability and about alternatives and opportunities for addressing these differential dimensions. Insights from this analysis need to be conveyed broadly to decision-makers at all levels, including donors, NGOs, communities, households and market actors as well as the government. This wide communication (along with assured access to and exchange of information) is essential because information is not neutral and, as emphasised in the preceding section, a wide variety of actors each with their own perspectives make up the governance and decision-making environment. Information is, in effect, the text for negotiation between actors within the governance environment.

## Infrastructure

The small group on infrastructure emphasised that infrastructure needs to be understood within the realm of the natural or the physical system, human-built system and the social system. All three directly and indirectly impinge upon flood and drought hazards and how they affect populations.

The first area discussed by the group in which understanding has to improve is weather processes, including hydro-meteorology. Collection, collation and dissemination of data on rainfall, river flow, sediment discharge and geomorphology is essential. Furthermore, the manner in which such information is generated, disseminated, analysed and controlled establishes the text on which perspectives are formed and solutions negotiated. Information is not neutral: instead, different institutional contexts are biased toward generating the information (or disinformation) that supports their worldview. As a result, diverse sources of information are important and organisations that produce primary baseline information (such as rainfall, stream flow data, low flow and flood flow, and groundwater level) will be needed.

A second infrastructure dimension discussed by the group involves the behaviour of human-built systems, both existing ones and proposed ones. The performance and functioning of built infrastructure must be continuously assessed and updated. Infrastructure such as bridges, barrages, dams and embankments modifies the hydrologic dynamics of river and groundwater systems. While infrastructure is often constructed with the objective of alleviating flood impacts, it can also exacerbate hazards through, for example, drainage congestion. One major source of such problems is that structures are frequently designed on the basis of knowledge systems that were originally developed in temperate climates and may not apply to

many situations in South Asia or other parts of the world. Practices that are not locally rooted have often become embedded in the normal activities of water management organisations through education, the formulation of codes of design and global management practices. To counteract this, in-depth understanding of infrastructure issues is required that will lead to new designs. Roads, for example, need to be designed in ways that facilitate access without constraining drainage. Existing bridges and culverts need to accommodate a flood of assumed probability without seriously burdening the natural environment. Exploring these issues requires analysis of design assumptions and methods, including costs and trade-offs. Equally important is the need to foster input from local communities. This enhances resilience by ensuring ownership of gains and enabling cost-sharing when drought or flood mitigation activities are undertaken. Moving in this direction also requires recognition that risk perceptions differ among groups even at local levels. As a result, the group indicated a need to shift from singular definitions of risk and its management that focus, for example, on the risk of failure of a given structure or the frequency of specific flood events, to more pluralistic perspectives.

This pluralistic perspective is essential in order to bring in forms of human-built infrastructure beyond that related to physical structures. In the case of agriculture, for instance, the presence or absence of institutional infrastructure such as seed and fodder banks, markets and local support organisations (such as dairy cooperatives) plays a central role in the creation and mitigation of risk. Many of the issues and opportunities associated with such infrastructure are highly location-specific. They depend, for example, on the presence or absence of different organisations at different geographic levels within a flood- or drought-affected region. In order to develop effective response strategies, this implies a need to build on knowledge at the community level and suggests that synergistic activities (i.e. those that build on existing social infrastructure) are likely to be more effective than strategies that poorly reflect existing local social infrastructure. Needless to say, decentralisation and devolution, rather than administrative de-concentration, helps attain these ends.

Because of the highly location-specific nature of social infrastructure, learning processes that build on pilot activities designed to reduce vulnerability were seen as key by participants in the small group. Opportunities for this may be particularly present where local finances can be mobilised using existing social networks or other local organisations such as self-help groups to support specific inputs that appear likely to reduce vulnerability. In the case of housing, for example, partnerships between local and external support organisations to construct new housing or retrofit existing stock to make it flood- or drought-resilient could serve as a key pilot activity. With decentralised delivery mechanisms (such as self-help groups) in place, it may be possible to utilise external sources of financing much more effectively and efficiently. Pilot activities and learning processes that seek to

link external inputs to local social infrastructure opportunities could have both immediate practical results and improve understanding of the interaction between external support and the nature of local social infrastructure.

Overall, the small group on infrastructure emphasised the interdependency of social and physical infrastructure in determining the resilience of local livelihoods. It also emphasised that the complex interactions between social and physical infrastructure implies a need both for pilot projects and for activities that encourage learning. Pilot activities that focus on shelter and housing and that seek to link external support with the development of local social infrastructure were seen as particularly promising. In addition, activities that encourage other forms of learning and communication, including the use of diverse forms of communication in local languages and larger South-South exchanges for knowledge-sharing and so on were seen as essential. Analysis of success stories is important, but we can also learn from failures and unsuccessful examples. Such reviews create learning opportunities that can help others avoid mistakes. Finally, the group viewed social auditors as having a critical role in the overall learning process. Social auditors are required as a catalyst for identifying livelihood alternatives as well as for contesting the policy terrain. Such contestation needs to be directed towards national policy-making as well as to the donors, international funding agencies and dominant forms of knowledge.

### **Economic and Social Inter-linkages**

Discussion within the small group on economic and social inter-linkages focused heavily on questions of migration. In the process of adaptation, migration plays a critical role by connecting populations in flood- and drought-affected areas with potential sources of economic and social support. Migration is not a unidirectional activity in which local populations are forced to flee flood- and drought-affected areas. Instead, it often involves flows in multiple directions both into and out of affected areas. Furthermore, it is often a proactive response to perceived economic opportunities as well as the constraints associated with floods and droughts that provide individuals and families with access to key sources of economic and social support. In many cases, income generated through migration forms the basis for productive investment back at home. As a result, some of the most critical issues revolve around questions of:

1. equitable access to the types of economic activities obtainable through migration;
2. the manner in which remittances are invested;
3. conditions in migrant receptor areas; and
4. the situation for those left behind when key individuals migrate.

At present, the ability to migrate and obtain access to non-farm economic opportunities is skewed. Even when such opportunities are generally available

within the wider economy, access requires both skills and financial resources. As a result, participants in the small group emphasised the importance of activities to build skills, particularly among vulnerable and less well-off sections of drought- and flood-affected communities. Skill development needs to be focused in areas where economic opportunities exist and can be accessed with reasonable levels of training. In many cases, as small group participants emphasised, specific opportunities are highly localised and reflect, for example, markets for traditional crafts or historical relationships. Other opportunities may, however, be much more generally available. Local populations often migrate or commute to work in the construction industry, a widespread growth industry that reflects the burgeoning nature of cities across South Asia. Training that enables local populations to access skilled work (carpentry, etc...) within this or similar industries could, as a result, substantially increase access to wider economic opportunities. Skills alone however, are unlikely to be sufficient. In many cases, the most vulnerable are unable to migrate or commute because they lack the financial resources to do so. As a result, small group participants emphasised the importance of social networks and institutional arrangements (such as loans through self-help groups or banks) that provide loans to migrants at reasonable rates of interest.

The manner in which remittances from migrants are invested in home locations also received substantial attention. As participants in the small group pointed out, remittances are critical to the resilience of livelihoods in many drought- and flood-affected areas. In Nepal, remittances exceed official development aid. They often serve as a key source of income to meet subsistence consumption needs during times of crisis. Equally importantly, they are a major source of investment in education and productive activities. In Orissa, for example, remittance income has become a source of modification of the agricultural system – people are investing in flood-adapted crops. In other areas, the families of migrants are using remittances to purchase land, improve their houses and as a source of capital to make loans to those in need. Migrants have, in some cases, become local-level moneylenders. This is fine for those with the money to lend, but probably also enforces existing patterns of social inequity within migrant source areas. This example was used to highlight the critical importance of institutions within the home locations.

In most regions, remittances are invested primarily in activities that benefit the families of individual migrants. While these are frequently productive, vulnerability at the community level can be reduced when remittance investments contribute to public as well as private goods. As small group participants pointed out, in some locations (such as Kutch in Gujarat), the presence of strong community-based organisations has served as a focal point that enables migrants to invest a portion of the remittances in watershed, education, infrastructure and similar activities of benefit to the wider community. As a result, the impact of migration on livelihood

resilience and adaptive capacity in home locations appears to depend heavily on the nature of institutions there. Better understanding of the linkage between remittance investment patterns and local institutions in home locations is essential and could contribute substantially to the development of adaptive, resilient livelihood systems.

Conditions in migrant receptor areas also received attention. As several participants in the group pointed out, lacking other options, migrants often move into urban slums and little attention is paid to their needs. Rajasthan has, however, recently developed a migrant resource centre. At least conceptually, such centres could play a critical role in mitigating the less positive side-effects of migration (such as disruption of education) in recipient locations. In a similar manner, participants emphasised the impact of migration on those left behind. Women, children and the old are often left with large burdens when other family members migrate. This can increase vulnerability. Overall, recognition of the critical role migration plays in enabling adaptation and livelihood resilience implies a need for concerted efforts to understand the positive and negative impacts of migration in both recipient and source areas and to identify specific courses of action for mitigating negative aspects.

Beyond migration, participants noted a variety of other areas where such linkages play critical roles. These included:

1. The link between diversification within farming and animal husbandry systems and overall livelihood risk. In specific, the role of small ruminants (goats and sheep) and crop cycle management to reduce losses were emphasised as critical to risk reduction.
2. The link between local institutions and facilities and external market access. It was, for example, emphasised that equitable access to markets often depends on the presence of a local institution and/or storage facilities that enable farmers to store, process and sell local products without losing most of their profits to middlemen. The ability to diversify household livelihood systems is, as a result, often dependent on institutions and facilities available at a community level.

Results of the small group session pointed toward a series of key issues where additional understanding is required and points of leverage exist for increasing adaptive capacity and livelihood resilience in flood- and drought-affected regions.

Far greater attention needs to be paid to the role migration and remittance income play in adaptation and livelihood resilience. Major opportunities may exist in many home locations for supporting the development of resilient livelihoods if remittance income can be channelled in a manner that contributes to education, infrastructure

and the development of economic activities. Specific opportunities exist for pilot activities to do this by linking migrants with self-help groups. This said, better understanding is required regarding the incentives migrants face to invest in home locations and the diverse roles remittance income currently plays.

Similar opportunities for pilot activities and requirements for improved understanding exist regarding the challenges and requirements facing migrants in recipient locations. Resource centres and other support activities in source and recipient locations could, at least conceptually, improve their skills and mitigate the negative impacts of migration. Pilot activities and improved understanding of the migration process are, however, required in order to identify more widely applicable approaches.

