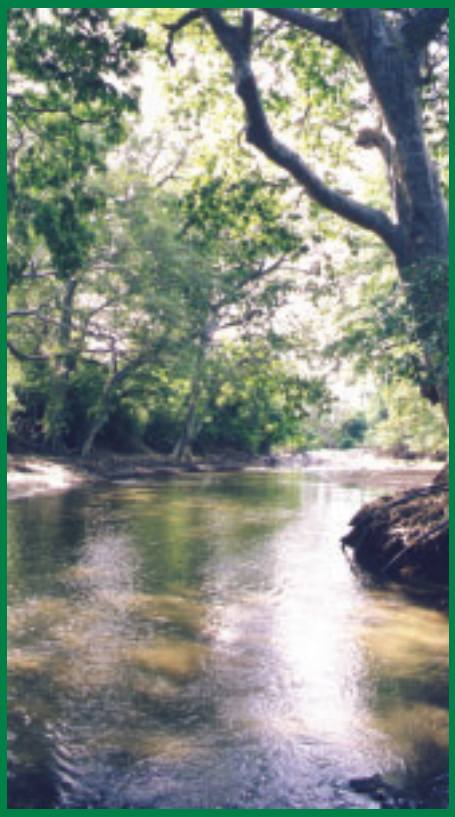
Water and Poverty Linkages

Case Studies from Nepal, Pakistan and Sri Lanka

Intizar Hussain and Mark Giordano



IWMI International Water Management Institute

GWP

Project Report 1

Water and Poverty Linkages: Case Studies from Nepal, Pakistan and Sri Lanka

Intizar Hussain
and
Mark Giordano, editors

International Water Management Institute

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Chapter 1

Study Background

Intizar Hussain and Mark Giordano

There is growing recognition that there are strong linkages between water and poverty. However, the nature and direction of these linkages are unclear. On the one hand, many believe that water can drive socio-economic development, a view which provided impetus for the promotion of, and massive investment in, water resources development over the past five decades, to support such broad objectives as economic growth, rural and agricultural development, national food security, protection against famine and intensification of land use. These efforts are believed by many to have contributed to a considerable reduction in both absolute and chronic poverty, and hunger, in most developing countries. However, a contradictory view holds that while there might have been some positive outcomes, water resources development has also been environmentally destructive and unsustainable and has negatively affected both directly or indirectly, the lives of millions of people, in particular, the poor.

While these are two extreme views, they are tied by the agreement that there is a relationship between water and poverty and that water resources play a vital role, either positively or negatively, in the livelihoods of the world's most impoverished. Water is a socio-economic "good" when it contributes to domestic welfare, agricultural and other production, and the health of the environment. Water is a socio-economic "bad" when it brings water-borne diseases such as malaria and shistosomiasis, results in flooding, contributes to land degradation through water logging and salinization, or carries pollutants which harm humans and ecosystems. While the poor and marginalized can benefit greatly from the "goodies" water can deliver, it is also they who have the least power and ability to adopt preventive or defensive measures to combat the negative influences of water. For the poor in particular, then, improved management regimes are essential to enhance the benefits of water.

The Global Water Partnership, in its "Framework for Action," argues that the currently unsustainable water management practices, which mostly harm the poor, must be replaced by a holistic approach, based on the concept of Integrated Water Resource Management (IWRM). IWRM is seen as the means of providing water security, of creating sustainable water policies and practices and of reducing risks within the global water system. There are three fundamental components of IWRM: (1) Economic efficiency—using water with maximum possible economic benefit per unit; (2) Equity— equity in access to water at quantities and qualities adequate to sustain human well-being; and (3) Environmental and ecological sustainability—managing water in a way that does not undermine the life-support system, thereby compromising use by future generations (GWP 2000 Technical Report 4). The IWRM framework and approach recognize that complementary elements of an effective water resources management system must be developed and strengthened concurrently. These complementary elements include: (a) the enabling environment—the general framework of national policies, legislation and regulations and information for water resources management stakeholders; (b*)* the institutional roles and functions of the various administrative levels and

stakeholders; and (c) the management instruments, including operational instruments for effective regulation, monitoring and enforcement that enable the decision-makers to make informed choices between alternative actions. These choices need to be based on agreed policies, available resources, environmental impacts and the social and economic consequences.

In the June 2002 meeting of the South Asian Technical Advisory Committee (SASTAC) of the GWP in Colombo, it was decided to undertake case studies on water and poverty linkages in four different contexts. The results of those studies have already been made public at international fora, including the Asian Development Bank's (ADB) consultation meeting on rural water and poverty action initiative in September 2002, Dhaka, Bangladesh, and the Third World Water Forum held in Japan, and are now presented more formally in this report. While the case studies are not in-depth research projects, they do highlight important concepts and information on the linkages between water and poverty that may not be available elsewhere.

Some of the questions addressed in the case studies include:

- What are the characteristics of water and poverty issues and how are they linked to each other?
- Who are/were the poor and what are/were their water-related problems?
- What actions have been or are being undertaken by local communities and by external agencies to alleviate water problems of the poor?

Within that context, the main objectives of the case studies are to:

a) Identify and understand linkages between water and poverty

b) Develop an analytical framework for studying relationships between water-related poverty and using IWRM as a redeeming tool

c) Apply the framework to real-world situations

d) Identify constraints and opportunities for alleviating poverty through Integrated Water Resources Management approach

e) Draw implications and develop guidelines for effective implementation of IWRM for alleviation of water-related poverty.

More generally, the overall objective of the studies is to draw generic lessons and identify interventions that can help policy makers, planners and other stakeholders to develop actions that are effective in water resources management for the poor.

The case studies included in the report are all focused on South Asia, but all with differing geographic contexts or thematic foci. The first case study examines the linkages between water and poverty in general, in the context of a mountainous area in the Nepal Himalayas. The second not only focuses on the issue of water and poverty but also on its outcomes, in the face of drought within an already arid region of Pakistan's Baluchistan province. The third study turns to the role of health in the water/poverty nexus and builds a conceptual framework to examine the issue based on information from Sri Lanka. The final study again focuses on Sri Lanka. This time, however,

the emphasis is on the role of irrigation in poverty reduction. The final section of the report draws a set of conclusions and lessons from the individual case studies, which can be used to inform future research and policy on the role of water in poverty alleviation.

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Chapter 2

Water and Poverty Linkages in Mountainous Areas: A Case Study from Nepal

Madan P. Pariyar[1]

INTRODUCTION

Improving water security for the poor has been a matter of immense concern in recent years. Water security in a broader context implies, that all people, including the poor, have access to water services and sanitation to meet their basic needs, are able to take advantage of the food security and income generation opportunities that water resources provide, are protected from water-related hazards, and have recourse where conflicts over water arise. Many developing countries have made large investments in water resource developments which were believed to have contributed to enhancement of food security and overall economic development. Empirical evidence, however, shows that water resources development has tended to favor the well-to-do sections of the communities and has widened the gap between the rich and the poor.

Much of the benefit of irrigation infrastructure, for example, has gone to the rich or large landholders who have the ownership of irrigable and fertile lowlands. The poor, who are often either landless, or have only a small patch of non-irrigated upland, are deprived of the benefits accruing from the irrigation investments, which mostly come from the national treasury or international grant/loan assistances. Likewise, many of the drinking water schemes constructed under a broader framework of action for ensuring health and hygiene to the common people, are tapped by influential sections of the society. The poor people, because of their sparse settlement, inability to contribute, unwillingness of the well-to-do communities, or for other reasons, do not have adequate access. Thus, while the overall impact of these developments may in fact be positive, it is possible that the situation in particular locations or for particular groups may be neutral or worse. The challenge, therefore, is to develop and manage water resources "to maximize the resulting economic and social welfare in an equitable manner."

To better understand the various linkages between agricultural water and poverty, it was decided by the South Asian Technical Advisory Committee to undertake case studies in four different situations in member countries. The overall goal of the case studies is to draw lessons and identify interventions that can help policy makers, planners and other stakeholders to develop actions that are effective in water resources management for the poor. This paper constitutes one of those case studies and focuses on the linkages of water and poverty in a mountainous area in the Nepal Himalayas.

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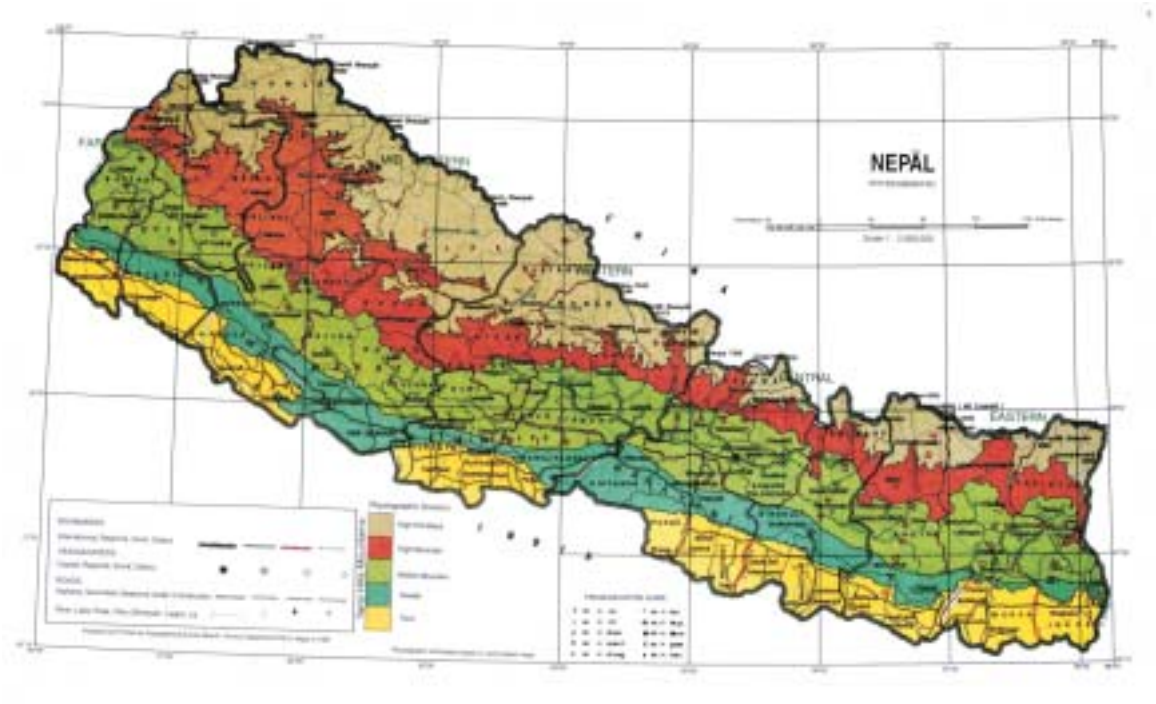
[1]With Dr. Pariyar as the Principal Investigator, the multi-disciplinary study team consisted of Mr. Purna L. Shristha, Ms. Amina Mahatyani, Mr. Ganga Ram Yadar and others.

COUNTRY BACKGROUND

Nepal, a landlocked country on the northern rim of South Asia, is bordered by China in the north and India in the east, south and west. Physically, stretching 880 km from east to west and 150-200 km from north to south, the country occupies a land area of 147,181 sq. km. Within the narrow width, it embodies a wide range of climate varying from the sub-tropical in the south to the cold temperate in the north. The average annual rainfall is 1,600 mm with 80 percent of it occurring during the monsoon. The winter is mostly dry.

The heterogeneous physiography divides the country into five major regions, viz., Terai, Siwaliks, Middle Mountains, High Mountains, and High Himalayas (figure 2.1). However, for the sake of brevity, the country is divided into three parallel ecological zones running east to west: Terai (includes Siwaliks), Hills (constituting mostly Middle Mountains), and Mountains (constituting the High Mountains and High Himalayas). These zones differ greatly from one another in topography and altitude. The Terai, an extension of the Indo-Gangetic plain, is a narrow strip of land along the southern border of the country. The elevation of the region ranges from 75 to 300 meters. In the north of the Terai lies the Hills characterized by a maze of deep valleys, hills and spurs. The northern extension of the belt is demarcated by a contour of 3,000 meters. The northernmost part of the country comprises the mountains which include Mount Everest, the world's highest peak.

Figure 2.1. Physiographic divisions of Nepal.



Only about 2.64 million hectares or roughly 18 percent of the total land area is cultivated. According to a recently conducted census, the country's population in 2001 was 23.2 million, and the average growth rate of population during the last decade was about 2.27 percent per annum (CBS 2001). The population is unevenly distributed across the three ecological regions, following closely the distribution of the cultivated land rather than total land area. The mountain region accounts for about 35 percent of the land area and 9 percent of the cultivated area, and is home to 7 percent of the country's population. The hill region (including the Siwaliks) covers 42 percent of the land and 40 percent of the cultivated area, and houses 47 percent of the population. The Terai region, covering 23 percent of the total land and 51 percent of the cultivated area, houses 46 percent of the country's population. Consequently, although population density per square kilometer of total land is very low in the mountains (36.6%) compared to the hills (167.4) and the Terai (330.8), population density per hectare of cultivated land is very high in all the three ecological zones, at more than 7. With the GNP per capita of US$220 per annum, Nepal is the 12th poorest country in the world and the poorest in South Asia (WDR 2002).

Figure 2.2. Administrative districts of Nepal.

The religious and linguistic divisions of Nepal also tend to follow the ecological divisions. The mountain population is dominated by the Tibeto-Burman speaking, largely Buddhist groups; the hill population by the Nepali speaking Hindu groups and the Terai population by the Indo-Aryan Hindu groups, mainly speaking Maithili and Bhojpuri. Nepali is the national language, but some 35 other languages and dialects are also spoken. The caste and ethnic compositions also mark great diversity, and the population is divided into more than 65 different caste/ethnic groups.

Administratively, the country is divided into five development regions (Eastern, Central, Western, Mid-western and Far-western Development Regions), 14 zones and 75 districts (figure 2.2). A district comprises Village Development Committees (VDCs) and municipalities. At the lowest level of division, each VDC is composed of nine wards, while the number of wards in a municipality ranges from 9 to 35. The total number of wards is 36,032, the number of VDC and municipality wards being 35,226 and 806, respectively.

The country can also be divided on the basis of rural or urban residence. The residence type reflects the status of development and availability of services required for a decent living. The municipalities are generally considered urban areas although some of the wards in municipalities may lack the services that qualify them to be a part of the municipality. The VDCs are considered rural areas. The average size of a household tends to be smaller (4.8 persons per household) in the urban than in rural areas (5.5 persons per household). About 16 percent of households live in the urban area against 14 percent of the population. On the other side, 84 percent of households live in the rural area against 86 percent of the population (CBS 2001).

Agriculture is the backbone of the Nepalese economy. Although its contribution to gross domestic product (GDP) is declining over time (from 70% in 1974/75 to 39% in 1999/00), it is still the largest economic sector. With about 80 percent of the rural labor force engaged in agriculture, agriculture is the main source of livelihood for the majority of the population. Agricultural development has received high priority in all development plans, programs and policies of the government in terms of the total capital outlay. The Agriculture Perspective Plan (APP), which has been endorsed by the government as the guiding document for planned agricultural development in the country also recognizes agriculture as the sector with the most potential for rapid transformation of the rural economy. Yet, the agriculture sector performance has been weak and unstable. With an average growth rate of 2.5 percent during the last decade, agricultural growth has been one of the lowest among all the major components of GDP and barely kept pace with the growth of population over the period 1991-2001 (ASPR 2002). The per capita growth of GDP in agriculture of 0.23 percent is still far from the goal of 3 percent proposed in the Agriculture Perspective Plan (APP 1995).

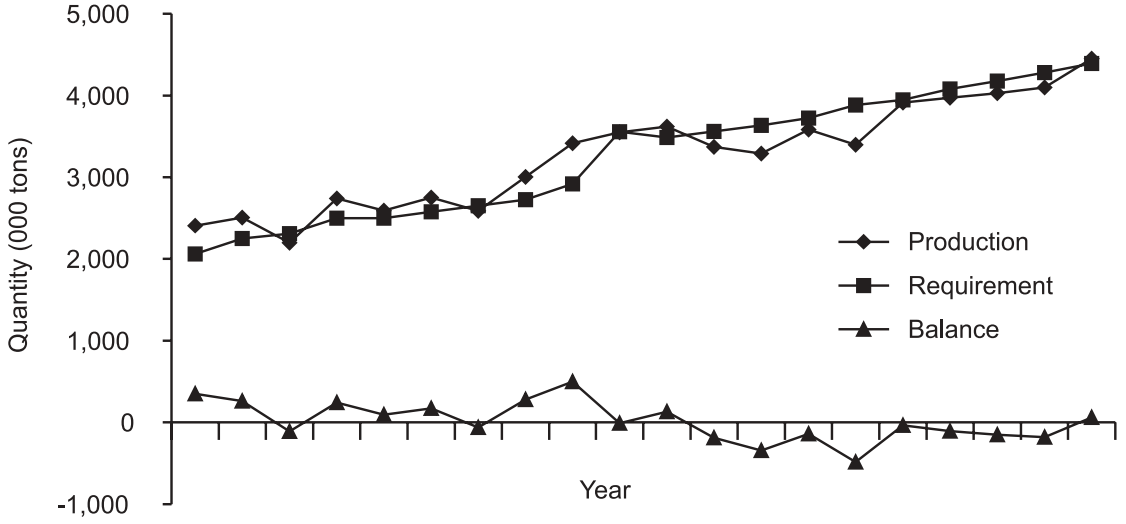
Low productivity, the slow rate of technological dissemination and its limited impact on production have confounded policy makers, planners and agriculturists. Low productivity has been attributed to the lack of environment-specific technologies, limited use of production inputs (irrigation, fertilizer and good quality seeds), and extension of cultivation to marginal land. Among the major factors responsible for poor performance of the agriculture sector is the inadequacy and unreliability of irrigation facilities. Irrigation being one of the key inputs for rapid growth in agricultural production,[2] its development has received high priority from farmers and government agencies. However, despite various efforts made in developing/extending the irrigation infrastructure,

[2]It is reported that the timely and adequate availability of water alone can contribute to as high as 25 percent increase in crop yields, besides contributing to crop intensification and diversification to high-value cash crops.

agriculture in Nepal remains largely dependent on the vagaries of weather. Out of a total of 2.64 million hectares of cultivated land, only about 42 percent (1.1 million hectares) receives irrigation. Year-round irrigation is available to only 0.45 million hectares of cultivated land.

Over the years, with increases in population, food demand has grown sharply but the production of food grain has increased only marginally. Consequently, food grain production has not kept pace with population growth rate. The trends in food production, requirement and balance during 1980-2000 are depicted in figure 2.3, which clearly indicates a general trend of highly fluctuating food availability. Weather conditions during production have always influenced the food balance situation in the following year. During the past decade, the level of food shortage reached 485,000 tons in 1995, gradually declined to 182,000 tons in 1999 and recorded a surplus in 2000.

Figure 2.3. Trends in Nepal's domestic food grain production, requirement and balance, 1980/81-1999/2000.



The food availability situation at the national level masks the actual extent of food insecurity prevalent in Nepal, as the situation varies greatly across regions and across districts within a region. Food shortages have remained a persistent problem in hill and mountain regions. It has been reported that 39 districts out of 75 in Nepal suffered from food deficiency in the fiscal year 2001/2002. In general, the severity of the food insecurity problem in a district is directly related to the remoteness of the district. The number of poverty stricken populace is increasing year after year.

Since the expansion of the land frontier for cultivation is no longer feasible, increases in agricultural production are possible only through increasing the productivity per unit area of cultivated land. This requires a shift from the current subsistence-oriented farming to high-value commercial agricultural production and to other agro-based income generating enterprises/opportunities, which might be locally sustainable.

The economy in Nepal is still mired in the initial stage of its development, where the income generated through the industrial sector as well as internal market expansion from the non-agricultural sector depends upon the development of the agriculture sector. Given the geographical diversity, only about one-sixth of land receives year-round irrigation facility and only one-fourth receives essentials used in production, and so only one-third of the potential productivity of agriculture has been realized at present. However, this could be raised through the use of state-of-art technology

(Economic Survey 2002). Thus, agriculture holds the main key to the reduction of poverty, and only through broad-based agricultural growth can a high and sustainable economic growth and improvement in the living conditions of poverty-stricken rural people be possible in Nepal. These are the realities prompting all development plans to accord high priority to the agriculture sector. It is also believed that the timely and adequate availability of water alone can contribute to substantial increases in crop yields, besides contributing to crop intensification, and diversification to high-value cash crops. Thus, water and poverty has a strong linkage in Nepal.

OBJECTIVES OF THE STUDY

The main objectives of the study are to: (1) identify and understand linkages between water and poverty in mountainous situations; (2) develop a framework for studying relationships between water and poverty with Integrated Water Resources Management (IWRM); (4) identify constraints and opportunities for alleviating poverty through water sector interventions.

Some of the questions to be addressed in the case study include: What are the characteristics of water and poverty issues in the mountainous areas of Nepal? How are these linked to each other? Who are/were the poor? What are/were their water-related problems? What actions have been or are being undertaken by local communities, and by external agencies? What has been the impact of these actions and are these actions/interventions sustainable?

AN OVERVIEW OF NEPAL'S WATER RESOURCES

Nepal is blessed with huge water resources potential. The country, though small in size, possesses about 2.27 percent of the world water resource, making it one of the most water-rich countries in South Asia. Total annual renewable water potential is 232 billion cubic meters: 224 billion cubic meters of surface runoff, which is 41 percent of the total discharge of the river Ganges, and eight billion cubic meters rechargeable groundwater. The total present annual consumptive use is less than 17 billion cubic meters and thus almost 92 percent of the renewable water potential remains surplus.

There are about 6000 rivers and rivulets in the country having a total drainage area of about 194,471 sq. km., of which about three-fourth lies in Nepal alone. The rivers can be typically classified into three types: major rivers, medium rivers and small rivers, depending on their source and discharge. The Kosi, Gandaki, Karnali and Mahakali are major river systems which originate in the Himalayas and carry snow-fed flows with significant discharge even in the dry season. The Mechi, Kankai, Kamala, Bagmati, West Rapti and Babai are medium rivers which originate in the Midlands or Mahabharat range of mountains and are fed by precipitation as well as groundwater regeneration including springs. These rivers are also perennial but are commonly characterized by a wide seasonal fluctuation in discharge. In addition to these river systems, there are a large number of small rivers in the Terai, which originate from the southern Siwalik range of hills. These rivers are seasonal with little flow during the dry season, and are characterized by flash floods during the monsoon.

Nepal has two rainy seasons: one from June to September when the southwest monsoon brings about 80 percent of its total annual rainfall, and the other in winter, accounting for the rest of the total amount of annual rainfall. About 64 percent of the rainfall goes immediately as surface runoff. Out of the remaining 36 percent, some is retained in the form of snow and ice in high Himalayas, some percolates through the ground as groundwater and some is lost by evaporation and transpiration. The retained water in the form of snow and groundwater acts as natural reservoirs which feed the rivers to keep them flowing during the dry season. The mean annual precipitation is 1,530 mm.

Besides surface water, Nepal is also endowed with extensive groundwater resources. Groundwater is found in most of the Terai (southern plains) and in some mid-hill valleys like the Kathmandu valley and the Dang valley. In the Terai, present annual withdrawal of groundwater for various purposes is estimated at 1.04 billion cubic meters, which is about 20 percent of the minimum possible annual recharge estimate of 5.80 billion cubic meters.

The influence of heavy rain during the monsoon causes wide variation in river flow, land erosion and landslides. Coupled with the extreme topographic relief and fragile geological composition of the country, these factors cause the rivers to carry high sediment loads during high flows. Besides this, snow and glacier melt also bring heavy loads of sediment during the summer months. The heavy sediment load in the rivers is an important factor in determining the extent of water-related hazards. This year, the country has observed unusually heavy rains during the monsoon. This has caused severe floods in the Terai plains and disastrous landslides and soil erosion in the hills and mountains. Losses to lives, crops and property have been enormous, and among the most affected are the poor and marginalized people who usually have their huts and land in flood and landslide/ erosion-prone areas.

The multifarious needs satisfied by the water resources in Nepal can be divided into two categories, namely, consumptive use and non-consumptive use. The most important non-consumptive use of water in Nepalese economy is in hydropower generation; while the consumptive use of water is primarily in three sectors, namely, agriculture, household and industry. Within the agriculture sector, water is mainly used for crop activities. As crop production is increasingly taking place under irrigated conditions, demand for irrigation water is steadily rising, and the overall demand for water would mainly continue to be from the agriculture sector.

Hydropower Potential, Development and Demand

The high slope and perennial run-off of the Nepalese rivers make the total theoretical hydropower potential at 83,000 MW, out of which 42,000 MW (table 2.1) is considered economically viable. Due to the large seasonal variability of discharge in the rivers, most of the economical potential power generation is based on big storage reservoirs. The promotion of non-consumptive use of water in hydropower generation could lead to additional production of hydropower for the country as well as export to neighboring countries. This could play a very important role for the prosperity of the country, mitigation of floods in Nepal, India and Bangladesh, and regulation of flow and conservation of water for the dry season.

Table 2.1. Basin-wise hydropower potential in Nepal.

River Basin	Theoretical potential (MW)			Economical
	Major rivers	Small rivers	Total	potential (MW)
Koshi	19,000	4,000	23,000	11,000
Gandaki	18,000	3,000	21,000	5,000
Karnali and Mahakali	32,000	3,000	35,000	25,000
Others	3,000	1,000	4,000	1,000
Total	72,000	11,000	83,000	42,000

Source: Framework for Action: Achieving Nepal Water Vision 2025.

Total installed capacity at present is 584 MW[3] which is only 0.7 percent of the potential and is not even sufficient to meet the internal demands of the country. Most of the current power plants are run-of-river type, and only some are storage power plants. Still, many virgin sites with high potential remain unused. The majority of the studied potential schemes are multipurpose and can provide benefits like irrigation, flood control, domestic water supply, navigation, and recreation. The regulated flow can provide huge benefits to downstream riparian countries, especially for irrigation and flood mitigation. The current situation of electricity supply can be summarized as follows:

- Only 20 percent of the population of Nepal is served with electricity connection.
- The electricity tariff in Nepal is one of the highest in the South Asian Region.
- Neighboring countries are also in short supply of electricity.
- The system loss in electricity is 23 percent, and 35 percent of electricity is unaccounted for.

Forecast of load in an optimistic scenario predicts a peak of 1,025 MW and 5,033 MW for the years 2005 and 2025, respectively. The Power System Master Plan for Nepal, prepared by the Nepal Electricity Authority, predicts that an additional 1,103 MW is required to meet internal demands by the year 2016. However, the plan is prepared to meet conservative domestic demands only.

Irrigation Potential, Development and Demand

About 67 percent of the cultivated land (1,766 thousand ha out of 2,641 thousand ha) in Nepal is reported irrigable. In addition to this, 0.412 million hectares of irrigable non-agricultural land (presently under forest) is available which makes the total potential irrigable land 2.178 million hectares by traditional irrigation methods. The remaining 0.875 million hectares of land, too, may be irrigable by modern technologies such as water harvesting and micro-irrigation and selection/ development of crops whose water requirements match availability.

[3]The Rising Nepal Daily, 20 August 2002.

Analysis of the distribution pattern of irrigable land in various ecological regions indicates that about 24 percent of cultivated land (55,000 ha out of 227,000 ha) in the mountains is irrigable, about 34 percent of the cultivated land (355,000 ha out of 1,054,000 ha) in the hills is irrigable, and almost all the cultivated land (1,356,000 ha out of 1,359,000 ha) in the Terai is irrigable (DOI 1990). While surface water is the only source of irrigation in the hills and mountains, both surface water and groundwater are the major sources of irrigation development in the Terai. Hence, the possibilities of harnessing these two resources within the socio-economic and technical constraints determine the potential of irrigation development in the country. It is reported that the country has surplus water resources for both surface and groundwater irrigation development of 1.8 million hectares of potentially irrigable land, and the country is using less than 8 percent of its water resource potential (APP 1995).

At present, irrigation water is provided to approximately 42 percent of the net cultivated land; 63 percent of irrigable cultivated area is irrigated, and 41 percent of irrigated area is being supplied with irrigation water on a year-round basis. Existing irrigation systems are the basis for almost 33 percent of the current agricultural production of the country. Table 2.2 summarizes the irrigation development status.

Table 2.2. Irrigation potential, and development status in 1999/2000.

Geographic region	Land area ('000 ha)	Cultivated area ('000 ha)	Cultivated irrigable area ('000 ha)	Irrigated area ('000 ha)	Year-round irrigated area ('000 ha)
Mountains	5,181.7	227	55	48	18
Hills	6,134.5	1,054	355	167	66
Terai	3,401.9	1,360	1,356	889	368
Totals	14,718.1	2,641	1,766	1,104	452

Source: Water Resources Strategy Nepal, 2001, and other documents.

The Agriculture Perspective Plan (APP) was launched in 1997, and it is hoped that around 612,000 hectares of irrigable land will be turned into an year-round irrigation system by giving emphasis to tube-well irrigation in the Terai. By the end of the APP in 2016/17, it is hoped that irrigation will command about 1.44 million hectares or 55 percent of the cultivable land, although the progress made till now is far behind the target (Pariyar 2002c).

The target for the years 2005 and 2025 is to cover 70 percent and 100 percent of the land. Correspondingly, the annual water requirement will be 23 and 37 billion cubic meters, respectively. The future irrigation water requirement will also be greatly influenced by the development plans, irrigation technology, cropping pattern and water stress imposed within a river basin by internal and external elements. If population growth cannot be checked and the increase in agricultural production cannot meet the demand, the forest land suitable for cultivation may be converted into agricultural land. There will be pressure for increasing cropping intensity to 300 percent. In this scenario, the total irrigation water demand would amount to 70 billion cubic meters per year.

Household and Industrial Water Potential, Development and Demand

Despite its huge water resources potential, one-third of Nepal's population does not have access to safe water. The latest domestic water supply coverage figures for rural and urban areas are shown in table 2.3.

Table 2.3. Coverage[4] of drinking water service in Nepal in 1998/99.

Development region	Total benefited population ('000)			
	Urban	%	Rural	%
Eastern	376	58	2,586	54
Central	1,191	79	3,834	63
Western	354	65	2,852	70
Mid-Western	155	67	2,012	74
Far-Western	105	43	1,555	85
Total	2,181	66	12,839	66

Source: Water Resources Strategy Nepal 2001.

Official estimates suggest that 66 percent[5] of the population have some access to drinking water facilities, and about one-fourth of the population has access to sanitation facilities. However, these figures are likely to be overestimated and the actual size of the population having access to such facilities is likely to be much smaller, both qualitatively and quantitatively. Not only is the coverage of drinking water and sanitation low, there is also wide disparity among the various regions. The hill and mountain regions show very low coverage (UNDP 2001). It is estimated that the total projected water use at the present pace of development by the end of 2005 and 2025 is 754 and 1825 million liters per day or 0.3 and 0.7 billion cubic meters per annum. The development target for domestic water supply is to provide tapped water to 100 percent of population by 2005. If done, the total water demand by 2025 for a whole projected population of 40 million at the rate of 200 liters per person per day is 3 billion cubic meters per annum.

Industries in Nepal are still in the early stage of development. The share of industrial sector is less than 10 percent of the country's GDP. The main industries in Nepal include cement, sugar, tobacco, alcohol, clothes, HDP pipes, plastic products, brick and tile, agricultural and forest products. According to the 1996 economic survey report, 311 industrial establishments were in operation and 58 new industries were under construction. Records of water requirements for these establishments are not available. However, it is expected that the industrial water requirements would rise, but it will only be a small fraction of the total water requirement.

[4]A person is deemed to have drinking water coverage if (s)he lives within 50 meters in altitude and 250 meters in horizontal distance of a drinking water source.

[5]A more recent report (NPC 2002) puts this figure at 69 percent.

Other Non-Consumptive Uses

There are other significant non-consumptive uses of water in Nepal that must be considered for water sector planning, as these may compete or conflict with other uses. Such uses include:

- Recreational/tourism uses—rafting, pleasure boating, bathing, aesthetic values of rivers, lakes and glaciers (e.g., for trekking, mountain climbing, sightseeing)
- Traditional/commercial fishing—catch and cage fisheries
- Navigation of rivers (mainly crossings but some rivers could be made navigable)
- Natural aquatic habit and wetlands (often associated with parks and wildlife reserves)
- Cultural and religious—temples, *ghats* of sacred waters
- Sand and gravel extraction from river beds
- Unique water sources or bottling spring water
- Large-scale industrial uses (for cooling or processing water).

Although these uses have not been well documented or quantified, they are important and their contribution to the economy is clear and needs to be better appreciated. These uses are likely to expand in future and, hence, should be included in the framework of IWRM.

POVERTY SITUATION IN NEPAL

Despite decades of development efforts, poverty remains pervasive and wide-spread in Nepal, and the overall living standards of a majority of population, especially in rural areas, are far below the acceptable levels. The poverty situation can be viewed from two perspectives, namely, economic and social (Upadhyaya 2000).

Economic Poverty

The estimate of poverty provided by the Nepal Living Standards Survey (NLSS) conducted by the Central Bureau of Statistics during 1994-95 places 42 percent of the population below the poverty line.[6] In urban areas, the percentage of population below the poverty line was estimated at 23 percent compared to 44 percent in the rural areas (NPC 1998). Given that close to 86 percent of the total population resides in rural areas, it is clear that, at least in terms of numbers, poverty is

[6]The Government of Nepal defines poverty line in terms of the value of an annual per capita consumption level considered just sufficient to assure 2,124 calories per person per day, plus a few essential non-food items. At average 1995/96 prices, the cost of food items able to fulfil the caloric requirement is estimated to be Rs 2,637, which can be interpreted as the "food" or "extreme" poverty line. The cost of essential non-food items when added to this cost, the resulting figure arrived at is Rs 4,404 (US$78.00, at the exchange rate of Rs 56.8 = US$1.00 for 1995/96) per person per annum, which can be taken as the basic poverty line.

Table 2.4. Poverty incidence in Nepal.

Area		Poverty incidence (percent)		
		Total	Poor	Ultra-poor
Ecological zone	Mountains	56.0	29.3	26.7
	Hills	41.0	21.3	19.7
	Terai	42.0	28.7	13.3
Sector	Urban	23.0	13.2	9.8
	Rural	44.0	26.4	17.6
National average		42.0	24.9	17.1

Source: The Ninth Plan (1997-2002), National Planning Commission, 1998.

Table 2.5. Poverty measures for Nepal, 1995/96.

Area		Head-count index (population below the poverty line)	Poverty gap index	Squared poverty gap index
Ecological zone	Mountains	0.56 (0.059)	0.185 (0.027)	0.082 (0.015)
	Hills	0.41 (0.031)	0.136 (0.014)	0.061 (0.008)
	Terai	0.42 (0.025)	0.099 (0.009)	0.034 (0.004)
Sector	Urban	0.23 (0.058)	0.070 (0.025)	0.028 (0.012)
	Rural	0.44 (0.020)	0.125 (0.008)	0.051 (0.004)

Note: Figures in parentheses are standard errors adjusted for stratification and clustering in the sample.
Source: Nepal Human Development Report 2001.

overwhelmingly a rural issue. As shown in table 2.4, the mountain region has the highest poverty level at 56 percent. Thus, the incidence of poverty is higher in rural than in urban areas and particularly extreme in more remote parts of rural areas.

Table 2.5 presents the poverty incidence, intensity (measured by the poverty gap index) and severity (measured by the squared poverty gap index) by region. At the national level, the poverty intensity is estimated at 0.12 and the severity at 0.05. However, these values in rural areas are twice as high as in the urban areas, suggesting that poverty is much more rampant, deeper and severe in rural areas than in urban areas. The same data suggests that the poverty situation in the mountain region is more rampant, deeper and more severe than that in the hills and the Terai. Likewise, poverty is more rampant in the hills than in the Terai.

Clearly, poverty appears to be mostly a rural phenomenon, with poorer people living in more fragile and vulnerable ecosystems of rural Nepal. Since 1996, no other surveys similar to NLSS have been conducted to measure changes in poverty incidence. Although based on the recently completed Mid-term Review of the Ninth Plan (1997-2002), it is officially claimed that there has been a reduction in the poverty level since 1996 by 4 percentage points, from 42 percent to 38 percent, at the national level the real poverty appears to be much higher. The situation is worst in the hills and mountains which provides residence to 54 percent of the population.

Social Poverty

The social indicators, reflecting the quality of life in Nepal, also paint a very gloomy picture. Gender disparities are large and persistent. Women and children are much more affected by poverty than men, in both rural and urban parts of the country. Nearly two-thirds of the adult population is illiterate. Malnutrition is widespread, and so is illness. About half of the children below 5 years of age are underweight. Infant and maternal mortality rates are among the highest in the world. Income disparities are also wide, both among regions and among households within a region. According to the NLSS data, the poorest 10 percent shared only 3.2 percent in consumption expenditure compared with 29.8 percent shared by the richest 10 percent.

Average life expectancy at birth is 58.6 years; women are expected to live fewer years than men. Only 41.8 percent of the adult population is literate, and the rate is much smaller among women than men. Less than one-third of the population has access to adequate sanitation facilities and about one-fifth of the population does not use any improved water sources. Less than one-third of births is attended by trained health workers (including traditional birth attendants). Infant and child mortality rates per 1,000 live births are still high, at 64 and 28 deaths, respectively. Undernourishment among children is common in rural areas, and again, a female child is more likely to be undernourished than a male child. The under-five mortality rate is estimated at 91 deaths per 1,000 live births.

The total fertility rate of women (age 15-49) is estimated at 4.1 children per woman; 2.1 for urban and 4.4 for rural areas. The rate has declined significantly in the past decade, from 5.1 in 1991 to 4.6 in 1996 and further to 4.1 in 2001. Similarly, there has been a considerable increase in the proportion of married woman in rural areas using a family planning method. According to a recent survey, 39 percent of married women use a family planning method and 35 percent use a modern method. Considerable improvements have also been recorded in child health care facilities in recent years.

The Human Development Report 2002 of the United Nations (UNDP 2002) has placed Nepal in the 142nd position in terms of Human Development Index (HDI) ranking among 173 countries. The HDI is estimated at 0.490, which reflects a significant improvement over the past two decades when the HDI for Nepal was 0.329 in 1980 and 0.415 in 1990. These figures indicate a low level of human development even by South Asian standards, and all countries in South Asia are better placed than Nepal in terms of HDI, except for Bangladesh (0.478). The Human Poverty Index (HPI) for Nepal is estimated at 43.4 percent with a rank of 76. This HPI value is higher (indicating a worse situation) than for any other South Asian country. The proportion of people earning less than $1.00 a day (1993 PPP) is estimated at 37.7 percent, much lower than the proportion estimated on the basis of the NLSS data collected in 1994. With respect to the Gender Development Index (GDI), Nepal has been placed in the 119th position among 173 countries.

Water-based Poverty Alleviation Initiatives

Poverty alleviation has been the main development agenda of Nepal since the 1970s. A number of programs have been launched since then targeting the poor, starting with the integrated rural development program. The Small Farmer Development Program (SFDP) launched in 1975 and the Production Credit for Rural Women (PCRW) Program launched later have been the prominent national programs targeting the rural poor. More recently, the government has launched the Bishweshor-with-the Poor (BWP) and *Mahila Jagriti* (Woman Empowerment) programs focusing

on the poorest and woman members of the rural community. In addition, a number of specialized programs are being implemented focusing on the backward and down-trodden communities.

Simultaneously, various national and international NGOs have been targeting their social and economic empowerment programs at the poor and disadvantaged groups, and their impacts have been significant, albeit in small and scattered pockets. Similarly, some NGOs are actively involved in promoting the production and marketing of high-value agricultural commodities, such as off-season vegetables, contributing to a significant increase in the incomes of small and marginal farmers in a short period. The role of NGOs in social mobilization has been particularly emphasized in recent years in all major poverty reduction programs of the government.

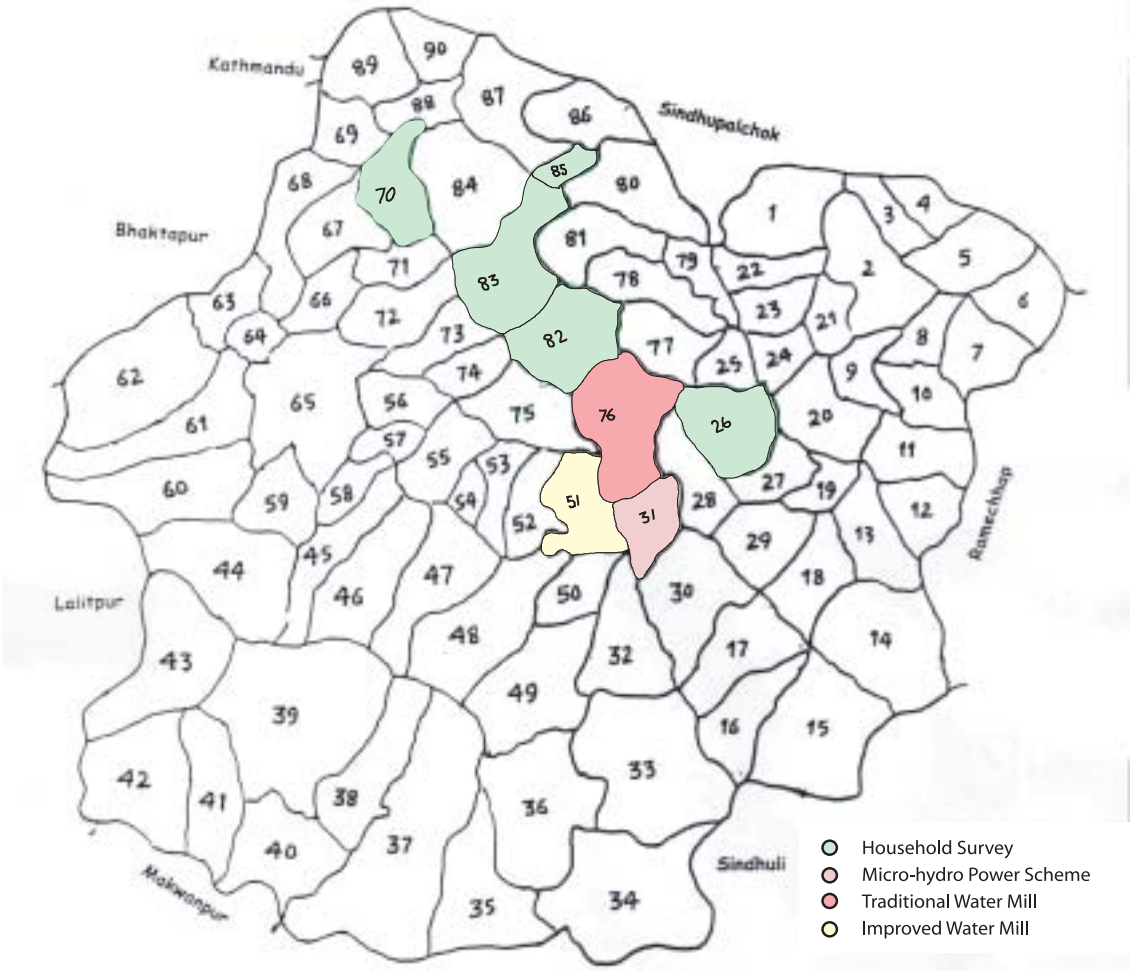
Water resources development has been a key component in most of the poverty alleviation plans, programs and initiatives. The highest importance accorded to irrigation development in the Agriculture Perspective Plan, the national commitment to provide safe water (for drinking and sanitation) to all Nepalese households, and the priority accorded to hydropower development for internal uses and export are a few of the examples that evince the importance of water resources in a broader perspective. At the village/farm level, the impact of micro-irrigation facilities can be observed in several districts, e.g., Dhankuta, Kavre and Surkhet, where poor farmers have switched over to high-value labor-intensive cash crops and, thereby, were able to raise their income several-fold. Along the road corridors or in accessible areas, the production of off-season vegetables has grown significantly while in remote inaccessible belts, the production of vegetable seeds is being picked up as a better alternative for the poor producers. In many villages, the farmers have initiated kitchen gardening, utilizing the waste water of their drinking water systems. This practice has opened up a new source of income for poor families, and the inclusion of vegetables in the daily diet has also enriched their nutrition level and health.

DESCRIPTION OF STUDY AREA

The area of examination for this case study is Kavre, a mid-hill district in the Bagmati zone of the Central Development Region, surrounded by Ramechhap and Dolakha districts in the east, Sindhupalchok district in the north, Kathmandu, Lalitpur and Bhaktapur districts in the west and Sindhuli and Makwanpur districts in the south. Kathmandu, the nation's capital, is 30 km away in the west of the district headquarters, Dhulikhel. The major types of climate in the district are sub-tropical, warm temperate and cool temperate. The temperature ranges from 10^0 to 31^0 Celsius. The elevation ranges from 200 m to 3018 m from mean sea level. About 97 percent of the district lies in the mid-mountain region.

There are 87 Village Development Committees (VDCs) and 3 municipalities (Banepa, Dhulikhel and Panauti) in the district. Figure 2.4 shows the boundaries of VDCs and municipalities, and the VDCs where field studies were carried out. The district population is estimated to be around 0.40 million, with a male to female ratio of almost 1:1. Out of a land area of about 0.14 million hectares, about 44 percent is cultivable. The current land use pattern shows that about 26 percent of the land is cultivated, 18 percent is cultivable uncultivated land, 28 percent is under forest, 24 percent is under shrubs, about 3 percent is under pasture, and the rest (1%) is under water bodies, settlements and other uses. Only 14 percent (4,950 ha) of cultivated land is irrigated.

Figure 2.4. Map of Kavre district showing the village development committees of the study.



87 Village Committees and 3 Municipalities					
1 Saping	16 Balting	31 Katunjebesi	46 Mahankalchaur	61 Kushadevi	76 Methinkot
2 Chaubas	17 Mangaltal	32 Sipali Chilaune	47 Khahare Pangu	62 Rayale	77 Kharelthok
3 Simthali	18 Kurubas	33 Budhakhani	48 Shikhar Ambote	63 Sanga	78 Sathighar
4 Ghartigaun	19 Boldephediche	34 Banakhu	49 Sisakhani	64 Mahendra Jyoti	79 Dolalghat
5 Sanuwangthali	20 Birta Deurali	35 Ghartichhap	50 Mahadevtar	65 Pamauti Municipality	80 Jayamdi Mandan
6 Nagre Gagarche	21 Salle Bhumlu	36 Phoksingtar	51 Khanalthok	66 Benepa Municipality	81 Hokse Bazar
7 Majhipheda	22 Bhumlutar	37 Gokule	52 Daraune Pokhari	67 Nala	82 Devbhumi Baluwa
8 Dhuseni	23 Phalante	38 Dandagaun	53 Dpcha Chhatrabas	68 Tukucha Nala	83 Panchkhal
9 Gothpani	24 Kolanti	39 Phalametar	54 Puranogaun	69 Nayagaun	84 Anekot
10 Pokhari Chauri	25 Kosidekha	40 Salme Chakla	55 Syampati	70 Devitar	85 Jaisithok
11 Kartike	26 Sarsyukharka	41 Saldhara	56 Batase	71 Ravi Opi	86 Chandeni
12 Kundan	27 Saramthali	42 Milche	57 Shankhu	72 Dhulikhel Municipality	87 Mandan
13 Thulo Parsel	28 Kanpur Kalapani	43 Chyamranbesi	58 Balthali	73 Kabhere Nityananda	88 Devpur
14 Machchegaun	29 Pokhan Narayansthan	44 Dhunkharka	59 Chalal	74 Patalekhet	89 Baluwapati Naldung
15 Bhimkhori	30 Kharpachok	45 Chyasinkharka	60 Kalante Bhumidanda	75 Phulbari	90 Gairibisauna Devpur

The district has a road network of 723.6 km. Three municipalities and 65 of the 87 VDCs are accessible by road. Electricity is available to 3 municipalities and 31 VDCs through the National Grid Line benefiting 19,000 households. Additionally, micro-hydroprojects and solar power panels have benefited 11 and 4 VDCs, respectively. Telephone service is available to 3 municipalities and 27 VDCs and postal service to all 87 VDCs. Drinking water facilities are available to about 65 percent of the population. There are 1 District Health Office, 3 hospitals, 10 health posts, 81 health sub-posts, 8 nursing homes, 5 ayurvedic pharmacies and 4 primary health centers providing health services in the district. Educational opportunities are provided by 509 primary schools, 112 lower secondary schools, 85 secondary schools, 9 higher secondary schools, 3 campuses and 2 universities.

Kavre is predominantly an agricultural district with almost 90 percent of its population dependent on agricultural activities for their day-to-day living. Agriculture, which encompasses both crop and livestock activities, is the backbone of the district's economy. The major agricultural products of the district are potato, tomato, seasonal vegetables and cereals. Due to the variation in altitude and the prevailing climates, a wide range of horticultural crops (fruits, vegetables, spices, herbs and flowers) are grown successfully. Being close to the metropolitan city of Kathmandu, there has been an assured market for agricultural products, though marketing facilities need to be improved. Since the road network within Kavre and outside has improved drastically, market forces have started imparting pressure towards commercialization in agriculture.

The district was food deficit in 1997/98 and 1998/99 and had a surplus in 1999/2000 (Nepal District Profile 2002). Based on the progress reports of Participatory District Development Program VDCs (21), about 22 percent of the households were food-sufficient for less than 3 months, 31 percent for 4-6 months, 25 percent for 6-9 months, 15 percent for 9-12 months and 7 percent for more than 12 months. The district has an immense potential for increasing agricultural production. Irrigation is one of the major constraints of agricultural development.

METHODOLOGY

The field study included focus group discussions (FGDs), key informant interviews (KIIs), household surveys, direct observations and walk-throughs. Semi-structured checklists were designed to administer the FGDs and KIIs. Likewise, a semi-structured, open-ended questionnaire was developed to administer the household survey.

A rapid field survey was conducted in selected VDCs/villages. The field staff visited each of the selected villages, interacted with locally knowledgeable persons, and prepared a list of households with preliminary data using a standard format. Altogether 588 households were enlisted. Based on the information received, the households were classified into (i) small, medium and large, (ii) irrigated and non-irrigated, and (iii) households with good access and poor access to drinking water. Thus, altogether 12 different household categories (SIG, MIG, LIG, SIP, MIP, LIP, SNG, MNG, LNG, SNP, MNP and LNP[7]) were identified, and households were grouped accordingly. For carrying out the detailed household survey, 7 percent of the population (enlisted households), i.e., 84 households, was considered to be a representative sample size. Since there were 12 different categories, 7 households were randomly selected from each category for the household-level survey.

[7]The first letter indicates size of landholding, the second letter indicates the status of irrigation, and the third letter reflects the accessibility to drinking water.

It was observed that each farm category contained no less than 14 households, i.e., 100 percent more than the sample size under each category. The households thus selected represent 8 villages belonging to 5 different VDCs (Maslotole village in Sarsyunkharka VDC, Majhdihi, and Panditdihi villages in Jaisithok VDC, Bakhreldihi village in Panchkhal VDC, Dandaghar and Pathagaun villages in Devbhumi Baluwa VDC, and Deurali and Mitinchhap villages in Devitar VDC).

One focus group discussion was conducted in each of the 8 selected villages. Additionally, a hydropower site at Katunje Besi VDC ward-1, and one *Ghatta* or traditional water mill site at Methinkot VDC, and one improved watermill site at Charenge Phedi village in Khanal Thok VDC were visited, and information were derived from beneficiaries of these water-powered technologies. Relevant data/information was collected, both for with and without, and before and after situation, wherever applicable. The field surveyors were advised to take notes on specific observation, if any, during field visits and walk-throughs.

Similarly, key informants from village health posts were also interviewed. Key informant interviews were conducted at various district-level offices, such as Agricultural Development Office, District Public Health Office, and District Soil Conservation Office. Consultative meetings at central level were held with various stakeholders including the government agencies/policymakers, experts, implementers, funding/donor agencies, researchers and development practitioners.

FINDINGS OF THE FIELD STUDIES

Demographic Characteristics

For analysis purposes, the sample households are broadly classified into four categories based on their access to water resources. Category-I households are the households that have good access to both irrigation and drinking water. Category-II households are the households that have good irrigation, but have poor access to drinking water supplies. Likewise, Category-III households are those that have good access to drinking water supplies, but have poor access to irrigation. And, finally, Category-IV households are those that have poor access to both irrigation and drinking water supplies.

Population distribution by age and gender

Table 2.6 presents the population distribution of sample households by age and gender. Of the total population covered in the study, 28.5 percent had good access to irrigation and drinking water, i.e., were in the first category, 21.1 percent had good irrigation facility but poor drinking water supply, 26.9 percent had poor access to irrigation but good drinking water supply and 23.5 percent had poor access to both irrigation and drinking water. As such, the populations covered under all the four categories are almost equal.

For farmers in all four categories, the male percentage was slightly higher than the female percentage, and in the case of children, the number of girls was less than the number of boys. The economically active population was highest (60.2%) in Category-III, and it was about 57 percent in the rest of the categories.

Table 2.6. Population distribution under different farm categories by age and sex.

Category	Below 14 years			Between 14 and 60			60 years and above			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Good access to irrigation and drinking water	36	28	64	47	50	97 (56.7)	5	5	10	88 (51.5)	83 (48.5)	171 (28.5)
Good access to irrigation but poor access to drinking water	28	19	47	34	39	73 (57.9)	3	3	6	65 (51.6)	61 (48.4)	126 (21.1)
Poor access to irrigation but good access to drinking water	36	19	55	44	53	97 (60.2)	4	5	9	84 (53)	77 (47)	161 (26.9)
Poor access to irrigation and drinking water	28	24	52	47	34	81 (57.4)	3	4	7	78 (55)	62 (45)	140 (23.5)

Table 2.7. Population distribution by VDC.

VDC	Below 14 years			Between 14 and 60			60 years and above			Total		
	Male	Female	Total	Male	Female	Total	Male	Female	Total	Male	Female	Total
Jaisithok	23	16	39	28	27	55	2	3	5	53 (53.53)	46 (46.47)	99
Baluwa	10	6	16	15	18	33	2	3	5	27 (50)	27 (50)	54
Devitar	58	39	97	72	77	149	6	6	12	136 (52.71)	122 (47.29)	258
Panchkhal	12	10	22	16	23	39	3	1	4	31 (47.69)	34 (52.31)	65
Sarsyunkharka	25	19	44	41	31	72	2	5	7	68 (55.28)	55 (44.72)	123
Total	128	90	218	172	176	348	15	18	33	315 (52.58)	284 (47.42)	599

Table 2.8. Average family size of sample households.

Category	Adults		Children		Total		
	Male	Female	Male	Female	Adults	Children	Total
Good access to irrigation and drinking water	2.48	2.62	1.71	1.33	5.10	3.05	8.14
Good access to irrigation but poor access to drinking water	1.76	2.00	1.33	0.90	3.76	2.24	6.00
Poor access to irrigation but good access to drinking water	2.29	2.76	1.71	0.90	5.05	2.62	7.67
Poor access to irrigation and drinking water	2.38	1.86	1.33	1.14	4.24	2.48	6.71

Population distribution by VDC

The population distribution by VDC was, however, not uniform. A total of 599 people belonging to 84 households were covered in this study. These households were spread over 5 VDCs. Devitar VDC had the highest sample population of 258, followed by Sarsyunkharka (123), Jaisithok (99), Panchkhal (65) and Baluwa (54). Out of the five VDCs, only Panchkhal showed a higher percentage of females to males while in the remaining VDCs the percentage of males was higher than females. The details are given in table 2.7.

Family size of sample households

The average family size of the Kavre district is 5.47 (2001 Census). The size of the family is greatly affected by whether a nuclear family or joint family system is followed. Table 2.8 shows the details of the family structure of the sample households. Family size was found to be larger in the case of the households with good access to drinking water than in cases with poor drinking water supply. One of the reasons for higher family size was the higher number of households with a joint family system in this category of households, and also, improved drinking water availability seems to have contributed to longevity. The family size was also related to farm size. The average family size of the small farmers was 5.96, medium farmers 7.04, and in case of the large farmers it was 8.39.

Social Characteristics

Level of education

The level of education and access to drinking water sources showed a direct relationship. Illiteracy was found to be highest in households with poor access to drinking water as compared to households with a good drinking water facility. During the survey it was observed that in households with poor access to drinking water, children (especially girls) and women were responsible for fetching water from far-off places. As a result, the children were deprived of schooling. Gender discrimination in education was also found to be prevalent in the study area. In most cases, once a girl child is grown up and strong enough to do household chores, she is taken out of school and absorbed into doing the family chores. As a result, there was a drastic reduction in females seeking higher education (beyond primary level), as compared to the males. The details of the levels of education of males and females under different farm categories are given in table 2.9.

Schooling of children

Different factors seem to be affecting schooling of boys and girls. While schooling of boys was mainly affected by irrigation status or indirectly by income, schooling of girls was affected by the drinking water status. It was observed that most of the parents were interested in sending their boys to school if they could afford to, financially. However, in the case of girls, access to drinking water was one of the major factors affecting their schooling, apart from income. In fetching water, mostly girls are involved, so if the family has good access to drinking water, the time spent on fetching water from distant places is saved, and the parents could afford to send their girl child to school. Details of the schooling of children are given in table 2.10.

Table 2.9. Level of education of sample population groups.

Category	Education of males						Education of females						Education of all					
	I	JL	P	S	>S	In	I	JL	P	S	>S	In	I	JL	P	S	>S	In
Good access to irrigation and drinking water	11	11	29	38	5	7	25	22	18	29	2	4	36	33	46	67	7	11
Good access to irrigation but poor access to drinking water	17	16	26	29	1	10	33	22	28	13	0	6	50	38	54	42	1	16
Poor access to irrigation but good access to drinking water	14	25	25	25	3	8	25	21	24	19	7	3	39	46	49	43	10	11
Poor access to irrigation and drinking water	19	24	25	12	14	5	39	22	27	9	0	5	58	46	52	21	14	10

Note: I-Illiterate, JL–Just literate, P–Primary level, S–SLC level, >S–Greater than SLC, In–Infants.

Table 2.10. Schooling of children.

Category	Total no. of boys, 18 or younger	Total no. of boys, 18 or younger, going to school	Total no, of girls, 18 or younger	Total no. of girls, 18 or younger, going to school
Good access to irrigation and drinking water	46	37 (80.4)	35	32 (91.4)
Good access to irrigation but poor access to drinking water	31	26 (83.8)	23	18 (78.2)
Poor access to irrigation but good access to drinking water	41	31 (75.3)	27	22 (81.4)
Poor access to irrigation and drinking water	34	27 (79.4)	27	21 (77.7)

Expenditure on education

Expenditure on education according to the access to water resources is given in table 2.11. From the table it is seen that expenditure on education is higher in the categories with good access to drinking water as compared to those with poor access to drinking water. However, the percentage of income spent on education is highest in the category with poor access to both irrigation and drinking water, as their income is low. Also, in this category, the number of persons seeking higher education is more; and hence, there is more expense on education. However, in the category with good access to irrigation but poor drinking water, the income is high but expenditure on education is low, and so percentage expenditure is also low. In this category, the number of girls going to school is low compared to the other categories, as they are required to fetch drinking water from long distances.

Table 2.11. Annual expenditure on education (in Rs; US$1.00 = Rs 81.04).

Category	Total expenditure	Total income	Percentage of total income
Good access to irrigation and drinking water	18,052	225,123	8.02
Good access to irrigation but poor access to drinking water	11,871	191,698	6.19
Poor access to irrigation but good access to drinking water	17,218	180,837	9.52
Poor access to irrigation and drinking water	16,128	118,541	13.61

Table 2.12. Percentages of people in various occupations, according to access to irrigation and drinking water.

Category	Occupation							
	Agriculture	Service	Wage earner	Business	Abroad	Studying	Infant	Un-employed
Good access to irrigation and drinking water	42.7	0.5	0.5	0.0	0.7	47.2	5.3	3.2
Good access to irrigation but poor access to drinking water	49.6	4.3	0.0	0.7	0.0	36.9	8.5	0.0
Poor access to irrigation but good access to drinking water	40.9	8.0	0.0	0.0	0.0	43.3	4.9	3.0
Poor access to irrigation and drinking water	40.9	7.4	0.0	3.8	0.0	38.8	4.8	4.3

Occupation

In the sample households, more than 40 percent of the economically active population was involved in agriculture. The percentage of people with agriculture as their main occupation was higher in the categories with good access to irrigation as compared to the category with poor access to irrigation (table 2.12). This is primarily because of higher yield and income from the farms in irrigated condition as compared to non-irrigated farms. When farm income is high, there is no need to seek other sources of income. In the case of households with poor irrigation access, the percentage of people with other sources of income like services or business was high, because of low yield and income from the farmlands. Likewise, a higher percentage of unemployment was seen in households with poor access to irrigation.

Migration

The migration figures indicate that migration was higher in the case of categories with poor access to irrigation. The survey revealed that people migrated for two primary reasons. First, some people migrated in search of employment, as the source of income in the village was not sufficient to meet the requirements of the family. Second, people also migrated to the city for higher education, as the possibilities were limited in the village. Migration seen in the category with good access to irrigation and drinking water was mainly for higher education, while in the categories with poor access to irrigation, migration was mainly for employment purposes. Table 2.13 gives details about the migration status of the sample population.

Table 2.13. Migration status of the sample population.

Category	Home			Away		
	Male	Female	Total	Male	Female	Total
Good access to irrigation and drinking water	84	83	167	4	0	4
Good access to irrigation but poor access to drinking water	64	63	127	0	0	0
Poor access to irrigation but good access to drinking water	80	74	154	4	3	7
Poor access to irrigation and drinking water	72	60	132	6	3	9

Drinking water

Tap/pipe, well, stone tap and spout were the major sources of drinking water in the study area VDCs. In households with good access to drinking water, well and tap/pipe were the major sources. For tap/pipe water, households had to make certain payments each month (about Rs 14.25 /month), and there was no scarcity period. Likewise, for households with poor access to drinking water, stone taps, wells and spouts were the major sources. They did not have to pay for the water on a regular basis but had to contribute to the repair and maintenance of the water sources. These groups of people also faced water scarcity in the months of March, April and May. The details are given in table 2.14.

Table 2.14. Drinking water status of the sample population.

Category	Source	Average one-way distance (meters)	Average one-way time (minutes)	Charge (Rs/month)	Deficit months
Good access to irrigation	Tap/well	46.67	3.86	14.25	None
Poor access to irrigation	Well/stone tap/spout	604.74	13.83	0.00	March, April and May

Table 2.15. Irrigation water status of the sample population.

Category	Water source		Charge		Deficit months	Average command area (ha)
	Khet	Bari	Rs/ year	Rs/ Ropani		
Good access to irrigation	Canal/ pipe	Canal/ pipe	435		March, April and May	66.61
Poor access to irrigation	Canal/ tank	Canal/ pipe/tank	500	28.75	February, March, April and May	32.38

Note: 20 Ropani = 1ha.

Agricultural Characteristics

Sources of irrigation

Streams/rivers/springs from which water is diverted to the fields through canal systems were the most dominant sources of irrigation water. Other irrigation sources included pipes and tanks. Broadly, land is classified into two types, the *khet* land and the *bari* land. Khet lands are mostly in the lowlands with easy access to irrigation while bari lands are in the uplands with low access to irrigation facilities. In most of the households, the irrigation was not year-round, but rather partial or seasonal, and there were water-deficit periods. The charges for irrigation also varied from place to place. In some places, payment was made on an annual basis, while in others it was made based on the area under irrigation/acreage. The details are given in table 2.15.

Landholding

Table 2.16 shows the average landholding and the land-tenure status according to access to water resources. From the table it is seen that the categories with good access to irrigation had a larger size of khet land than bari land and vice versa. This is because in the khet land, access to irrigation is much easier than in the bari land. The average landholding of the households with good access to irrigation is 0.84 hectares while that of households with poor access to irrigation is 0.95 hectares. Renting in and renting out of land is more common in the case of farmers with poor irrigation. Farmers with good irrigation facilities were not found to rent out land.

Crop production

In the study area, crop yield showed variation with irrigation status. In almost all the crops, the yield was higher in irrigated farms as compared to rain-fed farms except in the case of monsoon vegetables. In the case of vegetables grown in the monsoon season, the income was higher in the rain-fed condition (Rs 50,164/ha) as compared to irrigated condition (Rs 45,974/ha). Vegetables were found to be grown in bari land in the monsoon season in the study area. Bari land is suitable for vegetable production as it has good drainage. During field visits it was observed that the bari lands were closer to home and so were easier to look after, and people also used more inputs in these lands as compared to vegetables grown in khet land. So, if the rainwater was timely and adequate, higher yields were obtained. The details are given in table 2.17.

During focus group discussions, the respondent farmers revealed that increases in crop yield under irrigated condition were much higher when on-farm water management was practised and improved inputs such as hybrid seeds, chemical fertilizers and intensive agricultural extension services were used.

Table 2.16. Average size of landholding (ha/household).

Category		Irrigated				Rain-fed				Total			
	Land type	Own	Rented in	Rented out	Total	Own	Rented in	Rented out	Total	Own	Rented in	Rented out	Total
Good access to irrigation	Khet	0.36	0.00	0.02	0.38	0.00	0.00	0.00	0.00	0.36	0.00	0.02	0.38
	Bari	0.30	0.00	0.01	0.31	0.13	0.00	0.01	0.14	0.43	0.00	0.02	0.45
	Total	0.66	0.00	0.03	0.69	0.13	0.00	0.01	0.14	0.80	0.00	0.04	0.84
Poor access to irrigation	Khet	0.11	0.02	0.02	0.15	0.08	0.00	0.00	0.08	0.19	0.02	0.02	0.23
	Bari	0.01	0.00	0.00	0.01	0.65	0.02	0.02	0.69	0.66	0.02	0.02	0.70
	Total	0.12	0.02	0.02	0.16	0.73	0.02	0.02	0.77	0.86	0.04	0.04	0.94

Table 2.17. Area, production and productivity of crops by season under irrigated and rain-fed conditions.

Crops	Irrigated			Rain-fed		
	Area (ha)	Production (kg)	Yield (kg/ha)	Area (ha)	Production (kg)	Yield (kg/ha)
Monsoon paddy	22.34	89,650	4,268.08	2.95	10,950	3,887.88
Summer paddy	2.25	8,350	3,166.67	0.00	0	0.00
Wheat	10.80	19,320	1,835.95	2.60	3,180	1,450.56
Monsoon maize	11.20	29,900	2,827.21	10.10	23,874	2,437.03
Summer maize	11.64	32,409	2,971.98	20.38	48,555	2,641.62
Potato	7.78	109,514	15,861.55	1.60	11,950	11,583.33
Monsoon vegetables	0.44	22,000	45,974.03	1.40	78,800	50,164.50
Winter vegetables	5.83	452,000	91,512.70	0.84	22,500	23,888.89
Summer vegetables	3.78	333,000	97,034.25	0.40	11,500	20,000.00
Other monsoon crops	0.29	13,000	44,827.59	0.50	2,680	5,360.00
Other winter crops	1.45	15,257	10,616.88	0.25	1,975	7,583.33

Cropping Intensity

Cropping intensity was found to be higher in irrigated land than in rain-fed land. This was because of the fact that when there was sufficient irrigation, farmers cultivated various crops in the same piece of land and made maximum utilization of their resources. As agriculture formed the major source of income and employment for most of the sample farmers, they liked to grow additional crops, which accrued additional income for the family. As availability of family and hired labor was not much of a problem, availability of inputs, mainly, accounted for crop intensification and yield improvement.

The cropping intensity was also affected by the size of the farm, apart from the irrigation facility. In irrigated conditions, cropping intensity was highest in large farms, followed by small farms, and it was lowest in the case of medium farms. In rain-fed conditions, the cropping intensity was highest in small farms, followed by medium farms and lowest in large farms. In small farms, irrigation of the field manually by buckets and cans is possible as the land is small and needs less water. But in large farms it is not possible to irrigate the land by hand, and so, the land mostly remains fallow if there is no irrigation facility. Table 2.18 gives the cropping intensity by farm size and irrigation status.

As shown in figure 2.5, of the 36.68 hectares of irrigated land, 34.27 hectares were under various crops in the monsoon season. The most dominant crops in the monsoon season are paddy and maize. Vegetables and other crops take up a small area. During the winter season, 17.67 hectares of land were cultivated, in which wheat and potato were the most dominant crops grown. Likewise, in the summer season, the crops grown were maize, vegetables and paddy in a small area. Together, they covered an area of 25.86 hectares.

Of the 38.30 hectares of rain-fed land, 14.95 hectares were under crops during the monsoon season (figure 2.6). The cropped area was 20.78 hectares in the summer season and 5.29 hectares in winter. The most dominant crops in the monsoon season are maize, paddy and vegetables; in winter, wheat and potato; and during summer, maize and vegetables.

Economic Characteristics

In this survey, the economic status of the farmers was studied in two periods; one, before access to improved water resources, and the other, after access to improved water resources. With improved access, the yield potentials of land increased several-fold. With this view in mind, the respondent farmers were asked about their on-farm and off-farm income before and after access to improved water resources, in particular, improved irrigation.

Table 2.18. Cropping intensity by farm size and irrigation status.

Farm size	Irrigated			Rain-fed		
	Cultivated area (ha)	cropped area (ha)	Cropping intensity (%)	Cultivated area (ha)	cropped area (ha)	Cropping intensity (%)
Small Farms	5.10	9.70	190	4.72	6.33	134
Medium Farms	12.40	21.71	175	9.95	11.36	114
Large Farms	19.17	45.95	240	23.62	23.49	99
All Farms	36.67	77.36	211	38.29	41.18	108

Figure 2.5. Cropped area in irrigated land by season (hectares).

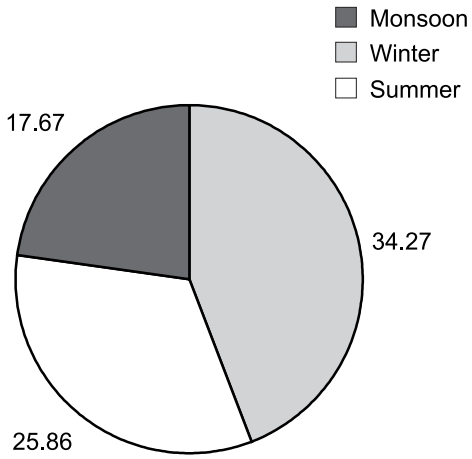
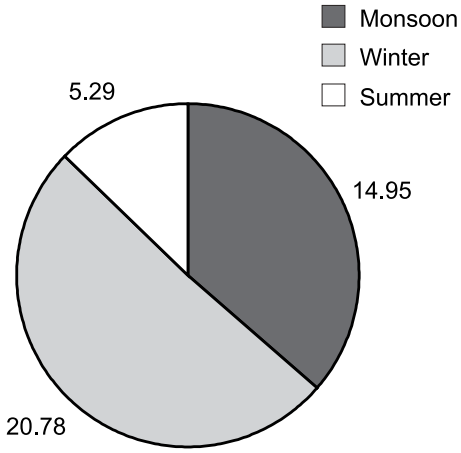


Figure 2.6. Cropped area in rain-fed land by season (hectares).



On-farm income

Farmers in the study area were involved in various farm activities like crop production, livestock raising, fishery, apiculture and others. Of all these farm activities, crop production formed the major share followed by livestock raising. Among the various categories of farmers, the farmers with good access to irrigation showed higher farm income compared to the farmers with poor access to irrigation. Livestock raising was related to availability of drinking water. The farmers with good access to drinking water were seen to be earning more from livestock than those with poor access to drinking water. The details about the farm income status by access to water resources are given in table 2.19.

During the focus group discussion, all the farmers opined that their farm income has increased since having improved access to irrigation and drinking water sources.

Off-farm income

Apart from the farm income, the families surveyed received income from various off-farm activities such as business, service pension or wages. Off-farm incomes were higher in the case of households with poor access to irrigation than those with good irrigation facilities. The details about the sources and amount of off-farm incomes are given in table 2.20.

Table 2.19. On-farm income status by category[8] (in rupees).

Category	Crop production	Livestock	Fishery	Apiculture	Others	Total income
Good access to irrigation and drinking water	202,851	18,667	0	0	1,429	222,947
Good access to irrigation but poor access to drinking water	171,941	14,952	0	0	3,703	190,596
Poor access to irrigation but good access to drinking water	155,800	19,905	0	71	1,429	177,205
Poor access to irrigation and drinking water	100,463	11,810	0	0	452	112,725

Table 2.20. Off-farm income status by category (in rupees).

Category	Business	Service	Wages	Others	Total
Good access to irrigation and drinking water	816	340	0	1,020	2,176
Good access to irrigation but poor access to drinking water	34	748	320	0	1,102
Poor access to irrigation but good access to drinking water	340	3,136	156	0	3,632
Poor access to irrigation and drinking water	1,224	2,272	156	2,163	5,815

Family income status

Total income figures revealed that on-farm income was much higher than off-farm income. Total income was found to be higher in categories with good access to irrigation than in categories with poor access to irrigation. This was due to higher farm income in these categories. Income status of households by access to water resources is given in table 2.21.

[8]The farm sizes in all the four categories were similar (0.90, 0.78, 0.93, and 0.97 ha, respectively).

Table 2.21. Farm income status by access to water resources (in rupees).

Category	On-farm income	Off-farm income	Total
Good access to irrigation and drinking water	222,947	2,176	225,123
Good access to irrigation but poor access to drinking water	190,596	1,102	191,698
Poor access to irrigation but good access to drinking water	177,205	3,632	180,837
Poor access to irrigation and drinking water	112,725	5,815	118,540

Food sufficiency

Among the various household categories, those with good access to irrigation and drinking water were found to be self-sufficient in food and the remaining categories had a food deficit. In order to meet the deficit situation, vegetable farming and earnings from wages were the two most important alternatives. After meeting the domestic requirements, any surplus was marketed by the farmers. This marketable surplus production by category is shown in table 2.22. In Nepal, agriculture is still by and large subsistence-oriented. Cereals form the staple diet for Nepalese households, so almost all the sample farms produced cereals like rice, wheat and maize for home consumption and very little was marketed. Vegetable consumption was rare, because of lack of awareness and low affordability, so almost all the vegetables grown in the field were marketed. Due to higher productivity, households with good access to irrigation had a larger marketable surplus production than those with poor irrigation facilities.

Table 2.22. Marketable surplus production by category.

Category		Marketable surplus production		
		Potato (Rs)	Vegetables (Rs)	Others (Rs)
With good access to irrigation	Average	1,993	13,833	20,828
	Total	83,701	581,000	874,760
With poor access to irrigation	Average	336	3,333	16,945
	Total	14,100	140,000	711,680

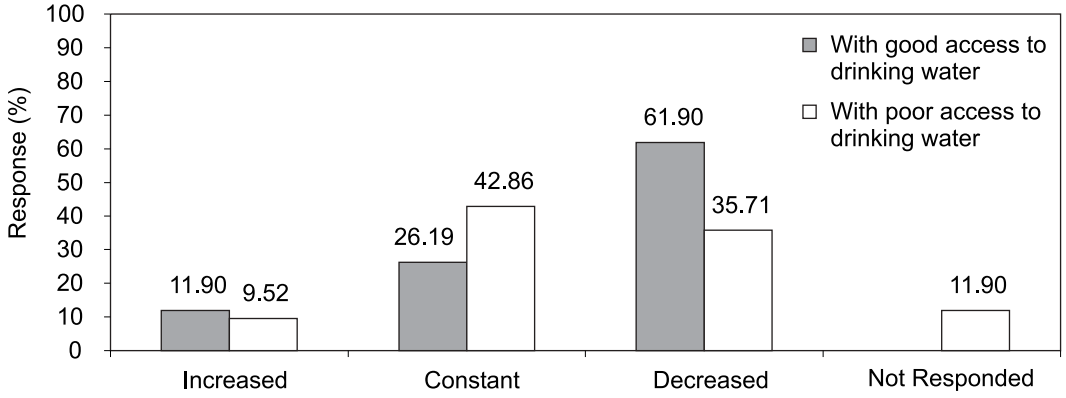
Health and Sanitation Characteristics

With better access to drinking water, the health status of people in the survey area has improved over the years. The incidence of water-borne diseases and skin diseases has reduced significantly, but the expenditure on health has, in fact, increased even after having access to improved water resources. This increase in expenditure was not because of increased health problems, but because of improved economic status and awareness regarding health care. There was also a difference in the expenses on health between households with good and poor access to irrigation. Higher expenditure on health for families with poor access to irrigation was because of their poor sanitation habits, leading to many health problems. Expenditure on education has also increased from Rs 2,699/year to Rs 4,890/year in the case of households with good access to water and from Rs 2,759/year to Rs 5,113/year in households with poor access to water.

Incidence of water-borne diseases

In this study, the respondents were asked about their views in relation to access to drinking water and the incidence of water-borne diseases such as diarrhea, dysentery and cholera. Though the response from farmers with good access to drinking water and from those with poor access to drinking water differed slightly, in totality, they were of the opinion that with improved access to drinking water, the incidence of the water-borne diseases has been reduced greatly. The details are given in figure 2.7.

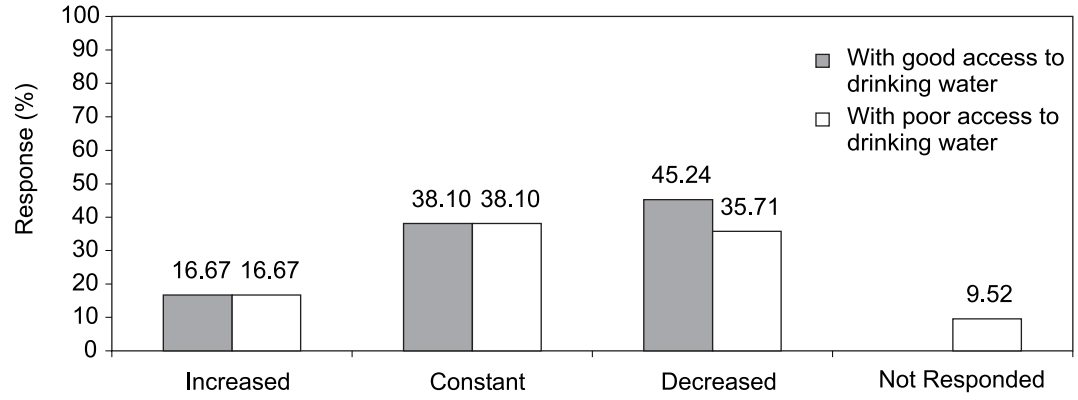
Figure 2.7. Incidence of water-borne diseases.



Incidence of skin diseases

In the case of skin diseases, 45 percent and 35 percent of the respondents with good and poor access to drinking water, respectively, said that the incidence of skin disease has reduced over the years. About 38 percent of respondents of both the categories opined that skin disease has remained constant, and 16 percent said that it has increased over time. The details are given in figure 2.8.

Figure 2.8. Incidence of skin diseases.



Incidence of mortality/physical inability

With respect to mortality and physical inability due to water related problems, 50 percent of the farmers with good access to drinking water said that mortality or physical inability has decreased after access to improved water resources, while 40 percent said it has remained constant and 10 percent did not respond. The views of farmers with poor access to water resources were slightly different. About 47 percent of the respondents in this category said that mortality/physical inability has remained constant over time and about 30 percent said it has decreased, while about 10 percent said it has increased over time. The details are presented in figure 2.9.

Figure 2.9. Incidence of mortality/physical inability.

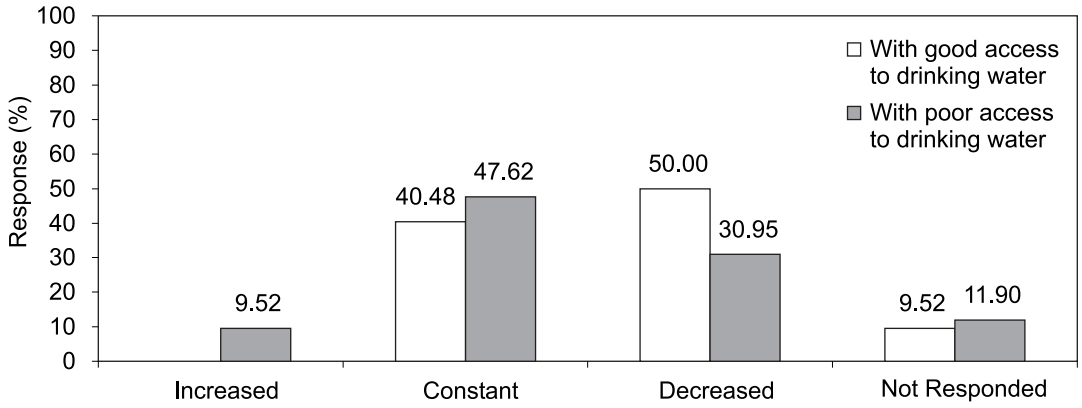
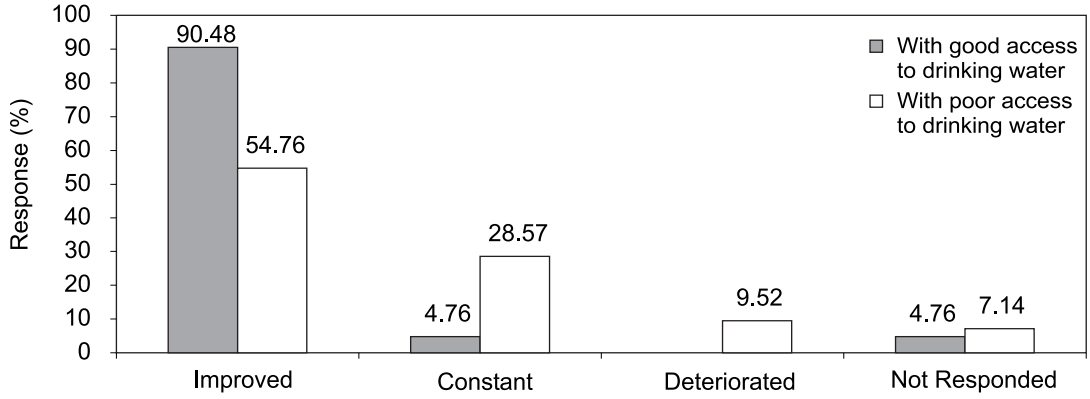


Figure 2.10. Sanitation condition.



Sanitation conditions

Poor sanitation conditions were found in the study area during the field visits. The whole study area was badly lacking in toilet facilities. Over the years, people have become more aware about the fact that good sanitation leads to healthy life, so there has been considerable improvements in the habits of the people, but further improvements are required. The sanitation condition was much better amongst households with good access to water than among those with poor access to water. The response of the farmers regarding the sanitation status before access to improved water resources and after is given in figure 2.10. Almost 90 percent of the farmers with good access to water said that their sanitation condition has improved, whereas 54 percent of farmers with poor access to water said that their sanitation conditions had not improved. This clearly showed the importance of water in improving sanitation and health status.

Environmental Indicators

Incidence of land degradation and flood

The respondents were asked about the status of land over a period of time before and after access to improved water resources. Most of them were of the opinion that the land has degraded with more use of irrigation over the years. Incidence of landslides and floods has increased. Improper irrigation has lead to loss of the fertile top soils. But these impacts were not merely due to irrigation alone. They were also due to increased population and encroachment in the forest areas. Increased deforestation and excessive cultivation of the forestlands have caused an imbalance in the environment leading to huge variation in weather conditions. The details of the farmers' response to the impact of water resources on land degradation and flood is given in figures 2.11 and figure 2.12, respectively.

Figure 2.11. Incidence of land degradation.

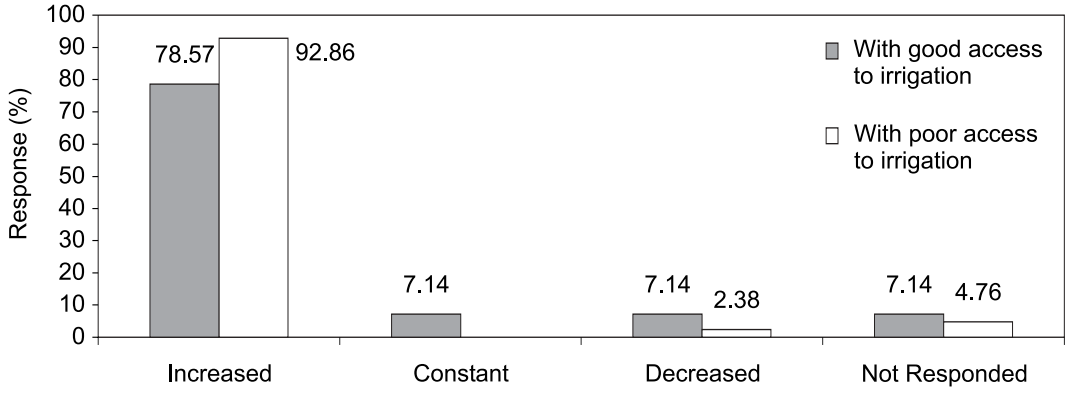
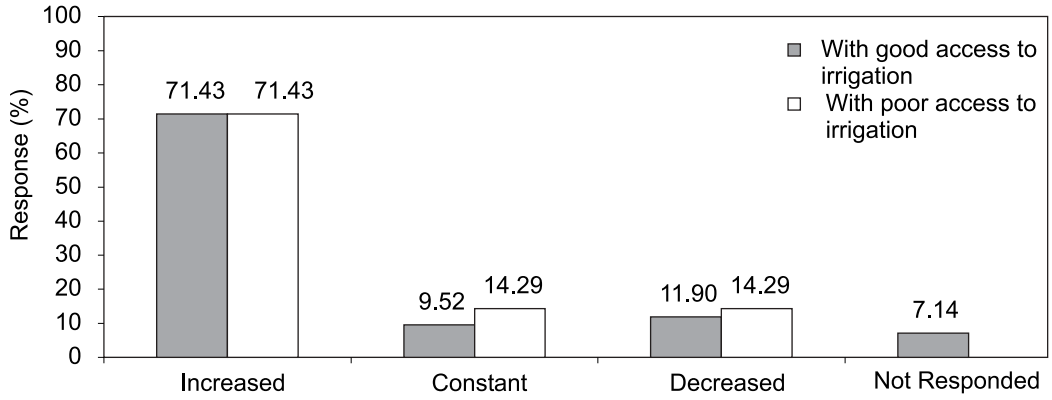


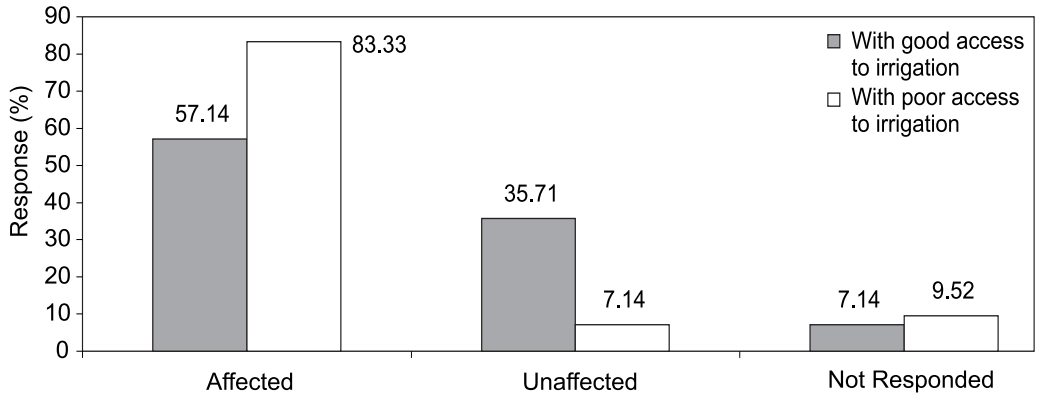
Figure 2.12. Incidence of flood.



Impact on aquatic life

In the study area, the most popular form of irrigation was diverting the river water by canals. This diversion of the rivers in an unmanaged way has affected the downstream flow of the rivers, which in turn has affected aquatic life. Rivers which were well-known for fresh water fish now dry up, particularly during non-monsoon seasons, because of water off-takes for irrigation. The drying of the rivers often pose a threat to both domesticated and wild animals who use the river water for quenching their thirst as well as for bathing and merry-making. The response of the farmers to the impact of water resources on aquatic life is given in figure 2.13. Most of the respondents from both categories were of the opinion that improved access to water resources has affected the aquatic life.

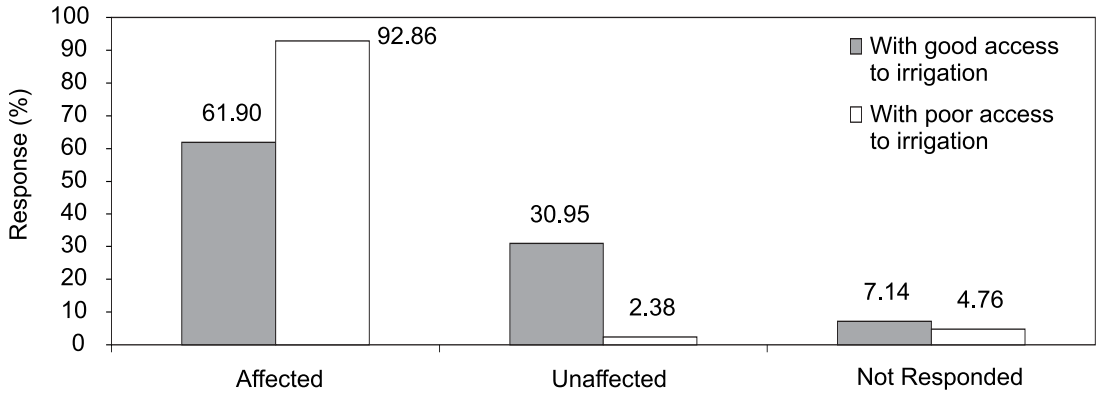
Figure 2.13. Impact on aquatic life.



Impact on vegetation

Unmanaged water resources have also affected the vegetation in the area. Even though there is ample scope for utilizing water resources, in reality this has not happened. Irrigation is highly limited and haphazard. Therefore, productivity of the land is not increasing on par with increasing population. This situation has increased pressure on land, forcing people to encroach on the forestlands, causing the forest in the study area to vanish at a very high rate. Farmers in the area were of the opinion that better irrigation facilities together with other technical and material inputs could stop this process and improve the vegetation condition of the area. Around 93 percent of the respondents with poor access to irrigation and 62 percent of respondents with good access to irrigation opined that improved water access has affected the vegetation status in their area. Their responses are shown in figure 2.14.

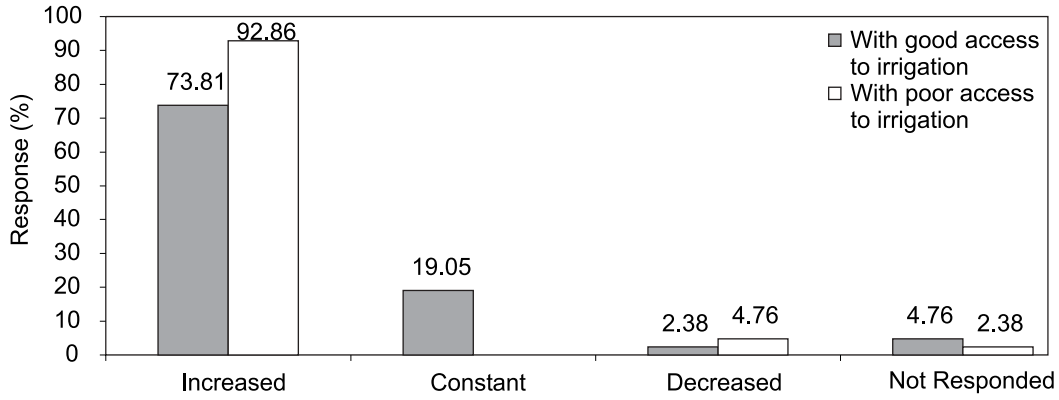
Figure 2.14. Vegetation status.



Incidence of mosquito nuisance

Mosquitoes are considered to be indicators of the sanitation condition of a place: the greater the number of mosquitoes, the dirtier is the environment. In the survey area, the mosquito nuisance has increased over the years. Even though mosquitoes have increased over the whole area, this problem was more prevalent in the case of households with poor access to water resources than those with good access to water resources. This was because of the difference seen in day-to-day habits like frequency of bathing, washing, cleaning etc. The general increase in the mosquito problem in the area was mainly due to the stagnating pools of water near water sources such as taps, wells, and spouts. Another reason for the increase in mosquitoes was the lack of toilet facilities in the area, even when water was available. Open defecation had also increased the mosquito problem. Ninety-three percent of the respondents with poor access to water resources, and 74 percent of those with good access to water resources opined, that mosquito problems have increased with more use of water in their area (figure 2.15).

Figure 2.15. Incidence of mosquito nuisance.



Physical indicators

Physical asset holding of the sample households was studied during the periods before access to improved water resources and after access to improved water resources. With the improvement in access to water resources, there has been a considerable increase in the physical asset holding of the farmers. This increase was higher in categories with good irrigation facilities than in categories with poor irrigation facilities. There was an impressive increment from Rs 10,600 to Rs 2,532,250 in the case of the category with good access to irrigation and drinking water. Increased asset position directly reflects improved economic conditions of the households. With improved access to water resources there has been a considerable increase in the income and economic status of the households in the study area. Details about the physical asset status of various categories of farmers before and after access to improved water resources are given in table 2.23.

Observations on Non-Consumptive Uses

Micro-hydropower scheme

The study team visited Roshi Khola Micro-Hydropower Scheme at Katunje Besi VDC Ward-1. This scheme was constructed with the assistance of the Rural Energy Development Project (REDP) of the UNDP (United Nations Development Program)-Nepal, in the year 2000. The total cost of the project was Rs 2,400,000, of which REDP contributed the electrical equipment, turbine, generator, etc. His Majesty of the Government of Nepal(HMGN) provided a grant assistance of Rs 195,000 and the rest was contributed by different agencies/sources such as VDC (Rs 100,000), District Development Committee(DDC) (Rs 50,000), Electoral Constituency Development Fund (Rs 25,000), Bank Loan (Rs 325,000), beneficiaries at Rs 1,100 per household, and other sources.

Table 2.23. Total physical asset position (before and after access to improved water resources).

Category	Radio				Cassette player				TV				Land(ha)			
	Before		After		Before		After		Before		After		Before		After	
	N	V	N	V	N	V	N	V	N	V	N	V	A	V	A	V
Good access to irrigation and drinking water	12	5.6	3	1.45	3	5.0	9	23.9	0	0	4	47.0	0	0	0.89	880.0
Good access to irrigation but poor access to drinking water	3	2.9	13	9.4	0	0	3	4.9	1	3.0	5	37.2	0	0	0	0
Poor access to irrigation but good access to drinking water	2	1.1	14	6.0	0	0	7	14.6	1	3.0	4	31.0	0	0	0	0
Poor access to irrigation and drinking water	1	0.5	14	7.85	0	0	3	10.7	1	4.0	2	10.5	0	0	0	0

	Mill				Tractor				House				Others				Total value (Rs)	
	Before		After		Before		After		Before		After		Before		After		Before	After
	N	V	N	V	N	V	N	V	N	V	N	V	N	V	N	V	V	V
Good access to irrigation and drinking water	0	0	3	60.0	0	0	1	20.0	0	0	2	1,500.0	0	0	0	0	10.6	2,532.35
Good access to irrigation but poor access to drinking water	0	0	0	0	0	0	1	125.0	0	0	0	0	0	0	3	29.0	5.9	205.5
Poor access to irrigation but good access to drinking water	0	0	1	70.0	0	0	0	0	0	0	0	0	0	0	3	40.0	4.1	161.6
Poor access to irrigation and drinking water	0	0	1	70.0	0	0	0	0	0	0	0	0	1	0.5	2	43.0	5.0	142.05

The specifications of the scheme are:

Name:	Roshi Khola Micro-Hydropower Scheme
Source:	Roshi Khola
Water Discharge:	400 lit/sec
Capacity:	8 KW
Canal Length:	650 m
Penstock:	Steel, Length 13 m
Turbine:	Propeller (Low Head)
Generator:	Single Phase, 13 KVA, 220 V, Induction
Controller:	I.G.C., 14 KW
Transmitter Length:	1410 m
Beneficiary Households:	47

There are a total of 55 households in the area but only 47 are the real beneficiaries. The remaining 7 households are barred from taking the benefit, because they did not contribute to the scheme's construction. These non-beneficiary households are too poor to make the necessary monetary and labor contribution, as a result of which they are unable to take advantage of the facility. The plant generates 8 KW which is distributed equally among the 47 households.

Earlier the charge for the electricity was Rs 1/watt/month but now it is charged on unit basis at the rate of Rs 5/unit. Since utilization of the electricity is not similar amongst the households, energy meters are fixed in each household to record the electrical units consumed. The money collected is kept in the bank account and is used for paying the operating persons and for maintenance of the plant. For the proper management of the plant, a 11-member committee is selected by the beneficiaries. This committee makes decisions on all matters related to the management of the scheme.

At present, the plant remains closed during the daytime, as electricity is used for lighting only during the nights. Lack of awareness regarding other uses has kept the households from making optimum use of the electricity. Also, the plant remains closed for about 2-3 months in a year because of plant breakdown, and the problems of washing away of the diversion structure by floods during the monsoon. The beneficiaries strongly urge for a permanent type of diversion structure to get rid of the threats of floods.

Access to electricity has greatly reduced the hardships faced by the people. It has created a better environment for children to study and helped to save money on kerosene. But so far, electricity has not been used for income-generating activities. This possibility needs to be looked into in future.

Traditional water mill

The study team visited a traditional water mill, locally called '*Ghatta,*' in Meringhat village of Methinkot VDC. The Ghatta is driven by running water diverted from the river Dapcha. The mill is used for grinding rice, wheat, maize, millet and other cereals. People residing within a 2-3 km radial distance from the mill, benefit from this facility. The beneficiaries expressed that the cereal flour of the mill is tastier and can be stored for a longer duration. The expansion of electricity-powered modern mills are, however, rapidly replacing the traditional water mills, because of their location in the midst of settlements/villages, higher output capacity, and possibilities for performing a range of agro-processing activities.

Improved watermill

The study team visited an improved watermill at Charenge Phedi village of Khanal Thok VDC. The total cost of the watermill was Rs 35,000. The mill was used for grinding rice, wheat and maize. It grinds 300 to 400 kilograms of cereal per day and generates a daily income of Rs 90 to Rs 120. Water from the Charenge River is diverted to run the watermill. The diverted water runs a micro-hydro scheme generating 200W and supplying electricity at night to 4 households. The tail-end water is diverted back to the watermill which carries out agro-processing. This way, farmers take multiple benefits from the establishment. It has not only enhanced their family income but has also improved their quality of living.

ISSUES IDENTIFIED

From the various reviews, household surveys, focus group discussions and key informant interviews conducted, a number of issues were identified. These are summarized below:

- There are many households without access to safe drinking water even today. Such families depend on far-off wells, stone taps and spouts for their drinking water needs. Even in households with good access to drinking water, round-the-year supply was available only to a limited section of the population and the remaining had to suffer from water scarcity during March-May. During this period they have to depend on alternative sources of water like wells, canals or even river water. Therefore, there is an urgent need to ensure safe drinking water round-the-year.

- Many households depend on wells for their drinking water needs. The quality of water during the monsoon season was bad in the wells, due to seepage. Construction of wells with cement rings will check this problem.

- Another problem seen in drinking water systems was the lack of drains near the taps/wells. Stagnating water pools act as a breeding ground for mosquitoes. Proper drainage and sanitation conditions can greatly reduce this problem.

- With increasing population, pressure on the existing drinking water sources is increasing. In order to meet the present and future requirements, construction of new wells and more tap water connections are needed.

- Benefits of irrigation have been maximum in areas where intensive agricultural supports, e.g., on-farm water management, availability of improved seeds, chemical fertilizers, plant protection chemicals and technology and extension services, are provided. In areas where these supports could not reach simultaneously, the benefits of irrigation were only nominal.

- Most of the land under irrigation had only partial irrigation. There was no or less irrigation during the months March-May. This has reduced the opportunity to cultivate the land and make some extra earning.

- The study area was sadly lacking in water harvesting methods. Capturing the run-off water in the rainy season in small ponds/reservoirs and using them later for irrigation was very rare. Being a mountainous area, this kind of water harvesting structure would have helped in irrigating the lands. Attention has to be given to the feasibility and development of such water harvesting structures.

- Improved access to water resources showed a direct impact on the food security situation of the households. Food and nutritional security was much better in the case of households with good access to irrigation and drinking water. Households with poor access to water showed a fragile food security situation.

- Electricity generated from the micro-hydro scheme is used for lighting during the nights. There is almost no use during the day time. As such, the plant remains closed during the day time, although water at the source remains available twenty-four hours. There are ample possibilities for utilizing day-time electricity generation in running several enterprises such as agro-processing – milling, grinding, oil expelling, saw mill, carpentry workshop etc., and this would greatly contribute to the economic well-being of the benefiting households. This component was not considered as part of the package in the hydropower development scheme.

- In order to have access to water resources, households need to contribute in the form of labor or cash or both. Contributions were required from every household irrespective of their economic level as per the prevailing rules, regulations and practices, and many times have led to the exclusion of the ultra-poor households which are incapable of making such contributions. This section of the society is thus left behind, and the gains from the access to water are reaped by better-off families. In the long run, this may widen the gap between the poor and the rest of the society.

- In the mountains, a community called *dalits*, or the so called low-caste people dwell all around, either in isolated clusters or in mixed settlements. These people belong to the ultra-poor Nepalese population who deserve preference in development activities. In fact, the government has time and again reiterated its commitment to accord higher priority for the welfare of the dalit community, but when it comes to actual operation/execution at the grass-roots level, this community is often left behind for different reasons, for e.g., their inability to contribute proportionately, ignorance, or unwillingness of other participating households to include them. The lack of specific provisions for these targeted groups along with a flat rule for participation has eventually excluded these poor families, who remain struggling for two square meals a day. A number of water-related projects thus suffer from this issue of equity.

SUMMARY AND CONCLUSIONS

Nepal's huge water resources remain largely untapped. The country possesses vast potential for hydro-electricity and irrigation development. These developments, which could appropriately be termed as a "blue revolution", can bring about an economic turnaround and foster poverty alleviation, an issue which will remain the country's most pressing concern in the decade ahead.

Water is mainly used for domestic (drinking water and sanitation) and irrigation purposes in the mountainous areas under study. The non-consumptive uses of water such as micro-hydropower generation and agro-processing through Ghattas and improved water mills[9] are also common.

This study has clearly evinced a strong linkage between water and poverty in the hills and mountainous regions. In general, water has contributed to reducing poverty and improving the quality of life of the people in the hills, though many a time, it has also accentuated poverty.

There are instances where the availability of piped water for domestic purposes has greatly contributed towards improvement of health and sanitation status. The incidence of water-borne diseases, such as diarrhea, dysentery and cholera, is reduced notably. Hygienic habits, e.g., taking baths regularly, washing clothes, and cleanliness, are enhanced, and these have led to a reduction in skin diseases as well. It is also observed that the family expenditure on medicines and healthcare has increased over time, but that these increases may not be necessarily due to increases in the occurrence of health problems. These increases are mostly indicators of enhanced affordability by farmer families, greater awareness of health care, and reduced dependence on traditional witch doctors.

The drudgery which the family members, especially women and children, have to bear in fetching water from long distances are also greatly reduced with the availability of drinking water. The time and labor saved in fetching water has resulted in better educational opportunities for the children and more income-generating activities for the women. This has ultimately helped to improve the economic status of the family. The waste water is often used for kitchen gardening, which contributes to the improved nourishment of the families.

It is also observed that emphasis on improvement and extension of sanitation facilities has not gone side-by-side with the availability of domestic water supplies. The surveys have revealed that only a few households among the beneficiaries of piped water supply have established toilets for their families. The habits of defecation in open fields or along the banks of rivers still prevail, and this practice is undesirable from an environmental point of view as well.

Farmers derive water for irrigation from rivers/streams, springs, capture ponds, and tanks integrated with micro-irrigation appliances such as drip, sprinkler or piped water supply. The most commonly used practice constitutes diverting the river/stream water by constructing temporary stone or wire brush dams and carrying water to the field through small channels. In some cases, spring water is tapped through the construction of small ponds or reservoirs. Diverting spring or stream water to a tank, and then conveying the water to the fields through low head sprinklers, drip irrigation system or closed pipes is also promoted, in recent years. Farmers have also built capture ponds which store the run-off, and the stored water is then diverted to fields as and when necessary.

The availability of irrigation water has greatly enhanced agricultural production and farm income. The productivity of crops and cropping intensity have increased; commercialization of agriculture through a shift from subsistence agriculture is fast becoming a reality, and crop

[9]The improved water mills generally Multi-purpose Power Units, contain metallic water wheels with cup-shaped metallic paddles. These mills are more efficient, and are used for several purposes such as milling, grinding, oil expelling, carpentry work, etc.

diversification through production of high-value cash crops such as off-season vegetables, vegetable seeds and fruits is taking place. All these changes together with enhancement of employment opportunities and agro-based enterprises have greatly enhanced the family income and the living standards of the people.

The food security situation is much better in the case of farmers possessing irrigated land. Their own production, in majority of the cases, is adequate to meet the family requirement. But farmers with poor access to irrigation are vulnerable to food insecurity. Family production is not sufficient to meet requirements throughout the year, and farmers have to resort to other sources of income including migration to other places for employment. In the case of farmers with irrigation facilities, family labor is more or less fully utilized in farming, and unemployment problems are minimal, while farmers with poor irrigation facilities suffer from both under-employment and unemployment.

Family income is much higher in the case of farmers with good access to irrigation. From the surveys conducted, on-farm income was observed to be dominant over off-farm income, and households with good irrigation facilities have higher on-farm income. Because of their increased income level, their physical asset position is also much better. They can afford to buy radio, cassette player, and TV from the saved money.

However, an adverse effect of irrigation is also seen in terms of deteriorating land conditions and aquatic life. Unmanaged irrigation has increased run-off, causing degradation of the cultivated lands. This has also resulted in an increased incidence of landslides. Unchecked diversion of river water through canals has reduced the downstream flow of water, which has adversely affected aquatic life. Lack of drainage systems and sanitation awareness of the people has resulted in increased mosquito population. Small pools of stagnating water near the taps and wells have become good breeding grounds for mosquitoes.

The hills and mountains are also characterized by existence of innumerable Ghattas (traditional water mills) which basically convert water power into mechanical power using wooden chutes, wooden water wheels containing straight wooden paddles, and grinding stones which are used for milling/grinding maize, wheat, rice and other cereals. The wide existence and popularity of these water mills is due to the remoteness of the area and lack of electricity supplies. Now-a-days improved water mills which can perform several agro-processing activities, are replacing the traditional Ghattas. Thus, this non-consumptive use of water has greatly facilitated the agro-processing activities and has relieved household members, especially women, from the backbreaking job of grinding and milling using traditional technologies such as, *Janto* (hand grinder), *dhiki* (pedal-operated pounder), *okhal* (hand pounder), etc.

In recent years, several micro-hydro schemes are also gaining in popularity in the mountain areas. The mountains by virtue of their topography, steep slopes, and perennial streams and rivers have immense potential for hydropower generation at the local level. This hydropower is especially of great significance, because of the sparse and highly scattered settlements in the hills and mountains, and also because of the high costs involved in expanding the national grid for electricity supplies to these areas. The majority of the population in the hills and mountains has remained almost completely dependent on kerosene lamps for lighting during the nights. The recent advancements in promoting micro-hydropower has certainly benefited these people by providing locally generated self-contained electricity supplies. A micro-hydropower plant installed in a survey site benefited 47 households by supplying them with 800 watts of electricity. Apart from lighting houses during the nights, some households could also use televisions, and some also expressed that education of their children improved, since children could study comfortably during the nights in their houses. Health hazards caused by kerosene smokes, and high costs involved in buying kerosene are also eliminated.

Overall, it is concluded that water plays a vital role in poverty alleviation. It has multiple roles in the socio-economic upliftment of the community, and the country as a whole. But water alone may not bring the expected results if it is not provided with other technical and material support. The efficiency of water in reducing poverty will be enhanced if there is better access to improved technologies and other material inputs along with access to improved water resources. The most important step is to generate awareness among the people on the various uses of water.

It is clear that most of the irrigated land in the hills and mountains has seasonal irrigation. There is scope to bring more area under irrigation. In addition, interventions that enhance access to other inputs (quality seeds, fertilizers, credit) and associated support services (e.g., marketing) will significantly enhance productivity and farm incomes. In water resources development, instead of focusing only on large-scale hydropower projects, attention should also be paid to micro-hydropower schemes, which are less expensive and feasible in the mountainous areas. These could serve as important sources of livelihood for the rural people. Finally, it is important to note that that most of the programs/projects dealing with poverty alleviation end up widening the gap between the ultra-poor and the poor in the society. While designing any program, it should be ensured that the ultra-poor are not left behind. This will require programs specially tailored for these specific target groups.

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Annex

Selected Voices from Case Study Participants

Tika Maya Tamang
Ward No. 2, Mitinichhap village
Devitar VDC.

We are a family of 7 members and we all depend on agriculture for our very survival. We have 1 hectare of land of which only 0.1 hectare is irrigated. In this land we take up maize in the monsoon season, wheat, mustard and vegetables in the winter season, in an area of 0.3 hectares. Due to lack of irrigation facilities no crop is taken up in the summer season and the field remains fallow. All the production is used for family consumption; even then, the farm produce is not sufficient to feed the family throughout the year. In the deficit months the family has to meet the food requirements by selling the livestock products and by taking temporary loans. Even though we have sufficient land to produce enough food for home consumption and marketing, because of lack of irrigation facilities we are not able to make maximum use of it. With assured irrigation facilities we could have taken up cash crops instead of the traditional crops and could have kept the land cultivated throughout the year. This would have improved our economic as well as social condition. Everyone neglects the poor. We don't have any say in the village because of our poor economic condition. Not only irrigation, we don't even have proper drinking water facility. For drinking purposes we collect water from the village tap. But for washing, cleaning etc., we don't have any particular source, as a result of which our sanitation condition is not good. Poor sanitation is the cause of most of our health problems but realization alone is not sufficient to solve the problem. I just wish that something could be done about utilizing the vast water resources that we have in our area to improve our livelihood.

Rudra Bahadur Baniya
Ward No. 7, Bakhreldihi, Panchkhal.

I have a joint family with 17 members. My brother and i stay together with our parents and children, and everybody is involved in the family farms. I have 1.25 hectares of bari land and 2.05 hectares of khet land. All the land is under irrigation. The bari land is irrigated by tank and the khet land by canals from the Jhiku river. In the khet land I take up paddy, potato/wheat and vegetable/Maize in the monsoon, winter and summer seasons, respectively. In the bari land I grow maize, vegetable/ mustard and vegetable in monsoon, winter and summer seasons, respectively. This way most of my land is cultivated round-the-year except for some areas in the summer season. I make an annual income of Rs 786,350 from crop production. Apart from that I also make an income of Rs 7,200/ year from livestock. Of the total income of Rs 793,600/year, 70 percent is spent on the family for education and other purposes, while the remaining 30 percent is saved in the bank. I completely owe my economic and social empowerment to good irrigation facilities. Because of good irrigation facilities, productivity of the crops in my land has improved, which has directly affected my economic and social status. As the income from the farm is sufficient to meet all my family's requirements I do not feel the need to go for any alternative source of income. As we don't face any kind of scarcity

we don't have much conflict among the family members and we all live happily and peacefully under the same roof.

I strongly believe that economic and social status is very closely linked. Because of my strong economic condition I can make lots of contributions for the village, and the village people give me lots of respect, in return. I am consulted for all minor as well as major decisions in the village, be it political or development issues. My social standing has improved a lot after having access to improved water resources. During the festivals, I can afford to celebrate in a grand way without much worry about the finances. For all these reasons, many younger people in the village consider me as a source of inspiration. I give them hope for a bright future in the village itself without having to move out for employment.

Health and sanitation conditions of my family are good because of easy access to drinking water. Since water is not a problem, regular bathing and cleaning of house is not a problem, which reduces the health problems. Also, my neighbors have benefited from this as they can fetch water from my place.

I believe that water and poverty are very closely interlinked. Fish without water and farming without irrigation is one and the same. Without water the farmland will be equivalent to a desert. I have understood the linkage between water and poverty to be as follows: land – irrigation – cultivation – production – income – economic and social empowerment – poverty alleviation.

Tika Ram Shrestha
Ward No. 4, Majhdihi, Jaisithok V.D.C.

I am an ex-Indian army personnel. After retiring from the service I am now completely involved in farming. I have 1.3 hectares of land in 4-5 parcels. Most of my land is irrigated. In 0.4 hectares of my land, canal irrigation was done for the last 30 years, but recently, I have been able to bring more area under irrigation by means of pipes. This has increased my farm income by way of vegetable cultivation and livestock raising.

From 1985 onwards I have clean drinking water supply in my house from taps. Before that, we used to drink water from rivers, spouts or wells. This improved access to drinking water has greatly reduced drudgery and health problems, in particular, infections. In 2002, I constructed toilets near my house at an expense of about Rs 7,000. This has improved the cleanliness of the surroundings and has made life more comfortable.

After having resided in India for nearly 20 years, I was used to lighting at night. The prevailing darkness in my home after my retirement was very uncomfortable. So my brothers and i together invested Rs 20,000 on a small turbine for electricity generation. It has a 200W production capacity that we distribute among our 4 households. Brighter nights have improved the studying environment for my children, who are now pursuing higher studies. Also, it has helped save the money spent on kerosene. Life is more comfortable and there is no smoky atmosphere anymore in the night.

Realizing the various uses of water, I have also started an improved water mill using the same water used for electricity generation. After being used in turbine, the water is then taken to the water mill through a small channel. This mill has become a good source of income for my family. Moreover, I also divert small water from the channels towards the kitchen garden in my backyard which helps to improve the nutritional status of my family.

I have also taken up 2 buffaloes and some poultry. Two liters of milk is used for home consumption and the remaining sold in the market. In the case of poultry, eggs produced are used for home consumption, which has improved the dietary habits of my family.

Chapter 3

Pro-poor Water Harvesting Systems in Drought-prone Areas: A Case Study of the Karez System in Baluchistan, Pakistan[10]

Virginia Appell, M. Saleem Baluch and Intizar Hussain

INTRODUCTION

This chapter analyses the relationship between drought and poverty in Turbat, south-western Baluchistan, Pakistan. Baluchistan borders with eastern Iran and south-western Afghanistan, areas which have also been severely affected by drought. To convey an idea of the magnitude of the problems caused by the drought, the first chapter outlines some of the effects of drought on Pakistan. It then moves on to an intensive study of the *karez*, an ancient water system that has made survival and prosperity possible in the perennially arid region of Baluchistan. The impacts of drought on karez-irrigated communities are analyzed in terms of impacts on crop productivity, livestock productivity, income, heath and nutritional effects, poverty and vulnerability, empowerment and participation, and sustainability of groundwater resources. The chapter then examines community and government-level responses to water scarcity, and outlines a strategy for integrated water resource management. Voices of the stake holders in the karez system, opinion leaders, government officials, and politicians are briefly presented, wherever necessary, to help enhance understanding of the strategy that must be put into place to reinvigorate community efforts to help restore their karez system, and to ensure its long-term sustainability.

THE DROUGHT PROBLEM

Drought refers to a condition of low rainfall over prolonged periods and denotes extreme scarcity of water resources. Drought is defined differently, and has different effects, in each of Pakistan's agro-ecological zones. As drought is a relative, rather than an absolute condition, these specific effects must be taken into account when analyzing the effects of drought, establishing drought mitigation efforts and planning for drought in the future.

Although drought is essentially a climatically-induced phenomenon, its actual effects in a given eco-zone and the viability of responses to it, will be mediated by ecological, social and infrastructural factors, as well as by the relevance, efficacy and timeliness of responses from Governments, NGOs and the private sector.

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[10]This paper is based on a study on "Mitigating the effects of drought through traditional and modern water supply systems in Baluchistan" implemented by the study team at National Rural Support Program (NRSP), Islamabad, Pakistan, in collaboration with the study team at IWMI. This study was undertaken for the Global Water Partnership, and the initial version of the paper was presented at SAWAF-II meeting in Islamabad, 14-16 December 2002.

Vulnerability to drought exists on a continuum in Pakistan. The basic eco-agricultural distinction in terms of normal rainfall is between irrigated[11]and *barani* (rain-fed) areas. A further distinction differentiates semi-arid areas from arid areas, and desert areas from semi-arid areas. All have suffered from the drought. Drought has created physical water scarcity and has generated considerable stress on natural waterways.

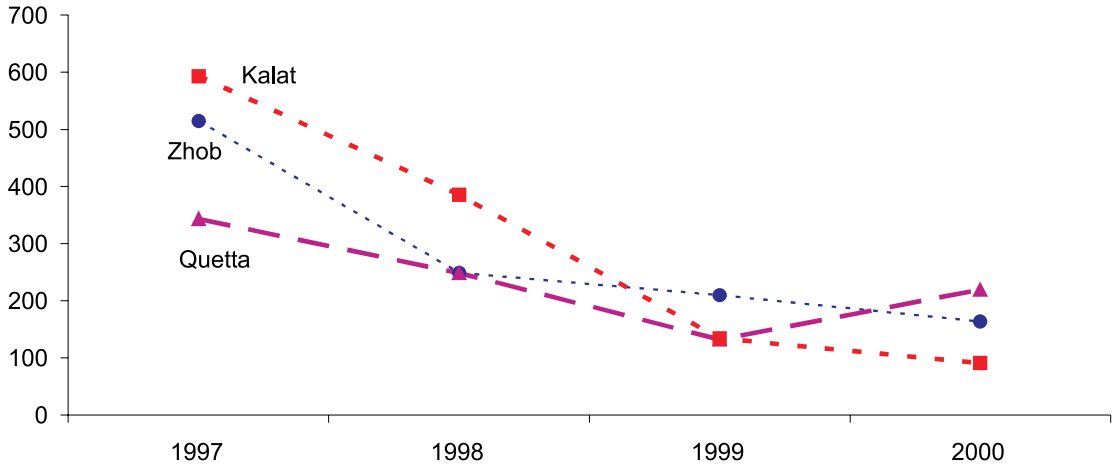
All areas in Baluchistan including Zhob in the north, Quetta in central Baluchistan and Kalat in the south, show a tremendous decrease in rainfall in the period shown i.e.,1997-2000. Figure 3.1 and the following figures give an idea of the scale of the problem in Baluchistan:

- In a normal year, some 32 million acre feet (MAF) of water from the Indus River flows into the sea; this was reduced to 2-5 MAF in the 3 years preceding 2001. Extreme drought conditions and global warming are cited as the reasons for the decrease. (Irrigation Department, GoB 2001). Increasing water shortages are predicted. In 2000, the shortfall was 40 MAF; this will reach 108 MAF in 2015, if present rates of water use continue.

- Total rainfall in Baluchistan and Sindh in 2001 was 50-60 percent below average according to the "Ten-Year Perspective Development Plan 2001-11," (Government of Pakistan).

Drought is a conceptually and operationally complex phenomenon. In addition to the climatic factors, communities' histories of coping with reduced rainfall, people's settlement patterns and economies (e.g., degrees of reliance on agriculture, livestock and horticulture for subsistence) will affect their ability to respond to drought. The nature of the mechanisms they have adopted over the years in response to drought is also important. People's access to power structures (political, governmental, community and household) will also affect their ability to respond. For these reasons, a close examination of a specific region can yield insights, not otherwise available.

Figure 3.1. Average annual rainfall in Baluchistan, 1997-2000.



Source: Agriculture statistics of Pakistan, 2000-2001, table 88.

[11]Pakistan has one of the world's most extensive irrigation systems. Unfortunately, its maintenance has not kept pace with the demand for water. Wastage through leaks and silting is also a problem. According to the Government of Baluchistan Irrigation Department, "the river Indus and its tributaries provide about 147 MAF of water during the flood season. Of this, nearly 106 MAF is available for agriculture … 32 MAF flows into the sea, and over 8.6 MAF is [lost to] evaporation and seepage losses". Irrigation Department. Government of Baluchistan. 2001.

The drought has severely taxed the capacities of communities in all eco-agricultural zones to sustain themselves economically, ecologically and socially. The current drought reveals the stark effects of many years of increasing water demand due to rapid population increases, enhanced demand for water-intensive cash crops, and increasing technological capacity to abstract water.

It must also be said that the drought reveals some degree of active and passive mismanagement, lack of foresight and poor governance in water resource management. Restoring eco-systems, infrastructure and communities to a state of health will require the kind of concerted approaches and interventions which have not been evident so far. Qazi (2000) states the problem well when he says that "the lack of a shared vision about the nature and magnitude of the problem and long-term sustainability of the resource amongst the various stakeholders, has prevented the formulation and implementation of an appropriate strategy to arrest the process of rapid degradation and eventual depletion of the resource."

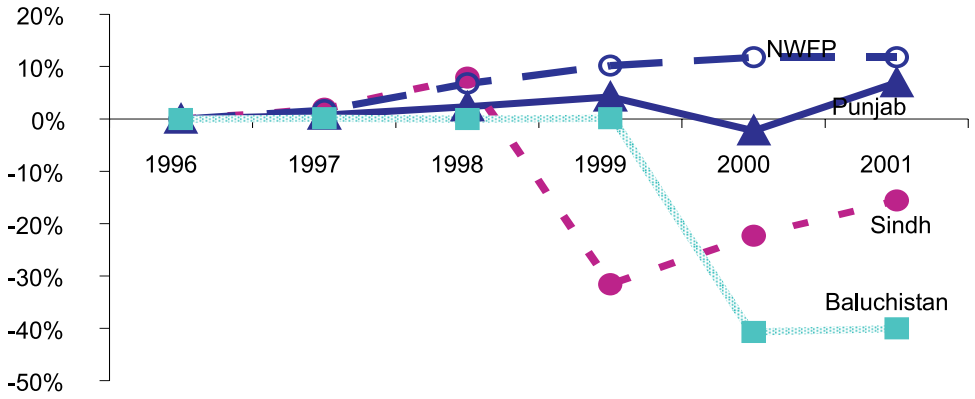
The socio-economic and environmental costs of drought and mismanagement include loss of crop productivity, including horticulture fruits and forestry products, over-exploitation and degradation of forest resources, loss of biodiversity, habitat degradation and over-exploitation of valuable species, rangeland deterioration, poor human health and malnutrition, poor educational outcome and high school dropouts, loss of employment opportunities and low labor productivity, low incomes, lower aggregate output and higher cost of living, which culminate in food insecurity for smallholders and daily-wage workers and expose them to higher than normal episodes of poverty and vulnerability. Gender effects include increased workload for women and girls, increased time and monetary costs in securing household drinking water supplies, and increased risk of assault, trauma, and other social abuse. Other impacts may include loss of income for coastal communities, over-exploitation of marine resources, violation of marine quotas and conflicts, deterioration of water quality, over-abstraction of groundwater resources, land degradation, air pollution, dust storms, land use changes, and possible social strife and ethnic and tribal conflicts. The economic impacts may include slow-down in economic growth, lower revenue, poor export performance, higher demand for imports, and weakening of government. Further, the long-term negative impacts would significantly outweigh short-term and immediate impacts. The complement of these costs is the lack of growth and development arising from reductions in human development indicators, and the loss of opportunities for advancing the state of human and economic development and combating poverty.

In 2001, the macro-economic impacts of drought on Pakistan's economy were starkly clear: According to a United Nations report,[12] "The State Bank has calculated the effect of the drought to the tune of US$927 million in the third quarter. As a result … the anticipated GDP growth rate of 4.5% will not be achieved, rather, the GDP growth rate will fall to less than 3% …" The report goes on to note Pakistan's dependence on agriculture, and the resultant "increase on imports [which will] thus adversely affect the Balance of Trade of the country". Furthermore, the drought reduces the country's ability to produce electricity, meaning that oil must be purchased for this purpose (ibid). This fact alone has caused "an additional loss of nearly US$1.2 billion" (ibid).

Figures 3.2 - 3.4 show the reduction in crop yields by area planted, in all four provinces, for major subsistence and cash crops, during the drought years.

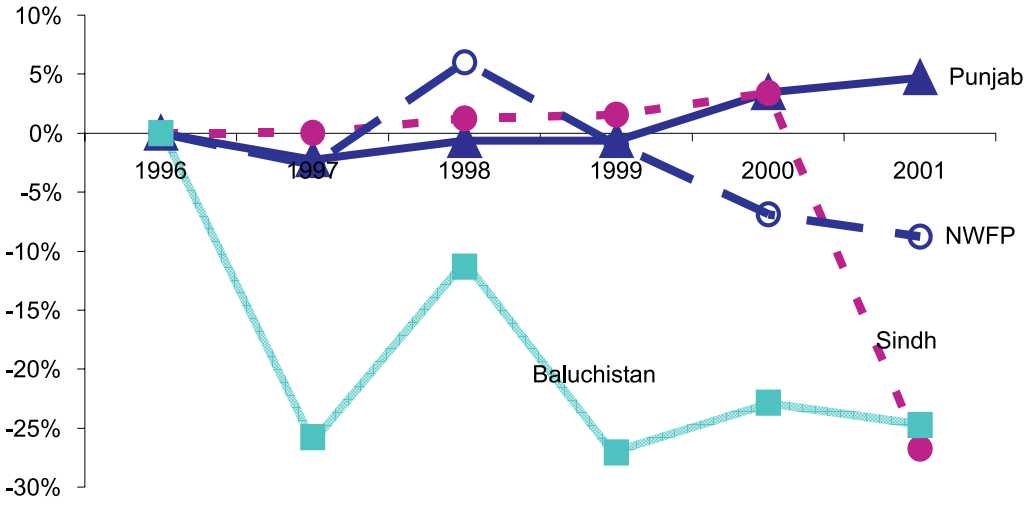
[12]Comments on Draft Framework for National Water Policy prepared by the Ministry of Water and Power, Government of Pakistan, April 2001, p3.

Figure 3.2. Percentage of change in date production ('000 tons), 1996-2001.



Source: Agriculture statistics of Pakistan, 2000-2001(table 56).

Figure 3.3 .Percentage change in wheat by area planted ('000 ha), 1996-2001, all provinces.

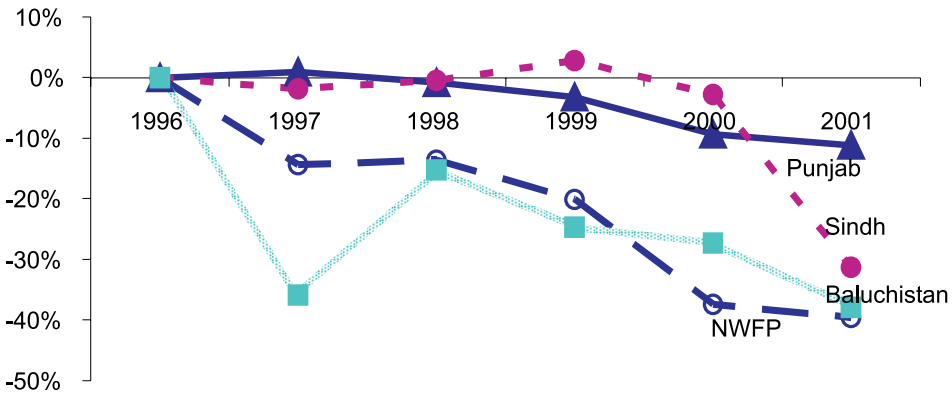


Source: Agriculture statistics of Pakistan, 2000-2001 (table 28).

According to the figures presented by the Chief (Environment), Planning Division, of the Government of Pakistan, the overall economic impact of the drought in 2001 was a reduction in real GDP (Gross Domestic Product) growth from a projected 4.8 percent to an actual 2.6 percent in 2000-2001. This means that Governments and international donor agencies must reserve large amounts of revenue and development funds for drought relief and mitigation. It essentially means that drought, and its direct and indirect effects, have impeded every aspect of economic growth.

The full social costs of the current drought will never be completely known. Some communities have been forced to disband altogether, as they migrate in search of fodder for their animals or paid work for adults. Children have been forced to leave school to help support their families. Families have been disrupted as male members have left in search of work. Elderly parents have been forced to beg. The effects of short-term and long-term malnutrition on infants, children, women and men will be felt for years to come.

Figure 3.4. Percentage change in all pulses by area planted('000 ha), 1996-2001.



Source: Agriculture statistics of Pakistan, 2000-2001(table 28).

DROUGHT AND POVERTY

Although the effects of drought have impacted all sections of community, those who are already poor are the most vulnerable. They have fewer resources for subsistence and fewer resources or assets to sustain themselves through the shocks that drought entails. Their social support systems are dominated by people who are similarly poor, and therefore, unable to help except in limited ways. Many of the poor are rendered dependent on shopkeepers, middlemen, local influential people and the Government when their limited social safety systems are exhausted.

Drought also forces more people into poverty and debt as their resource and asset bases shrink. This is especially alarming given that some 35-40 percent of the total population, and even higher percentages of rural populations, are already living below the national poverty line (Human Development in South Asia Report 2000).Very high inequality in the distribution of land and capital resources in Baluchistan, further exposes the poor and smallholders to the disproportionately larger negative welfare effects of drought.

When poverty and malnutrition co-exist with a lack of water, poor to non-existent sanitation and polluted water supplies, the health situation enters a crisis. When gender biases are considered, it is evident that (a) the health situation in Baluchistan has reached this level of crisis and (b) that poor women are particularly vulnerable.

There is also what might be called technological and environmental costs of drought. Here, the best example is the tube-wells that provide artificial and unsustainable prosperity, while contributing to lowering of the water table. Anecdotal evidence of this was provided during a site visit to the Noshki area in Baluchistan by the UN Relief Commissioner in 2000. It was estimated that a single tubewell pumped out 600-800 gallons of water per hour, and that the pumps ran 24-hours a day, contributing to an increasing problem of groundwater over-exploitation.

DROUGHT IN BALUCHISTAN

Baluchistan is Pakistan's largest province in land area, covering 347,000 sq. km. or 44 percent of the country's total land. However, its population is only 6.6 million or 5 percent of the country's total population. This area is predominated by an arid climate. Most of the area receives only 150 mm rainfall annually, and mostly in the winter season. Rural areas are home to 85 percent of the population. Agriculture and livestock are the main economic activities in the rural areas. Due to traditional and historical practices in the arid climate of Baluchistan, the rearing of small ruminants is a predominant economic activity. Baluchistan contributes 46 percent of the sheep, 23 percent of the goats and 41 percent of the camels of the total animal population in Pakistan. However, the province produced just slightly over 50 percent of the amount of fodder required by the livestock (3.3m tonnes as against 6.3m tonnes) (ibid. p.4). The FAO reported (in 2000) 45-55 percent losses for sheep and 30-40 percent losses for goats.

Baluchistan features a typical arid and semi-arid climate with low and erratic rainfall. In the highlands of Baluchistan, high-value crops such as apple, apricots, grapes, melons, almond, cherry, onions and potatoes are grown through tube-well irrigation. There are more than 20,000 tube-wells throughout the province, and over the past 20 to 30 years the water table in many areas of highland Baluchistan has been dropping at the rate of 8 to 10 feet a year. This decline of the water table is due to indiscriminate installation of tube-wells by private individuals. Karezes, springs and other natural flows in seasonal streams are also drying up due to installation of wells, and low rains. The desertification process has started in these areas due to decline of the water table. The over use of ground water may result in low yield and inefficient use of abstraction energy. The problem of the water table decline is serious in the highlands of Baluchistan, which comprises approximately 53 percent of the province. The high-value orchards, mainly apples of exotic varieties, consume several times more water than traditional crops. In the present scenario of Baluchistan where institutional support and technology has led to a situation of drought-like condition due to over-mining of water, the issue of water crisis has become very complex (CAR 1998). Further more, Baluchistan is Pakistan's poorest province. Communication and transportation infrastructure is minimal outside Quetta, and there are few towns.

Baluchistan falls within the Mediterranean and monsoonal arid zone[13] which also encompasses parts of Afghanistan and western Iran (figure 3.5). Drought is a recurrent feature in this zone but the current drought has lasted longer than most previous episodes (7 years in the hardest hit places). 'Negligible' amounts of snowfall in the early 1990s[14] were a harbinger of the current crisis.

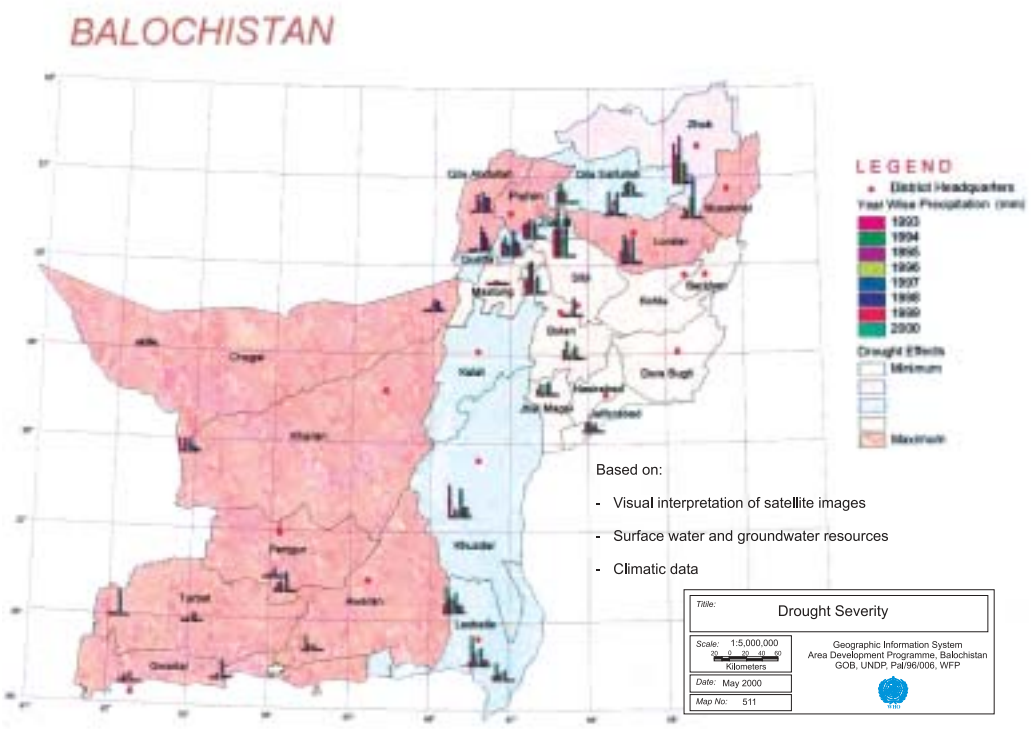
Table 3.1. Availability of water resources in Baluchistan (MAF).

	Available	Utilised	Balance
Surface water (Indus)			
Perennial	3.87	3.049	0.821
Flood	2.5	--	2.5
Surface water (flood runoff)	10	3	7
Groundwater	0.87	0.49	0.38
Total	17.24	6.539	10.701

[13]Baluchistan Board of Revenue: *Relief Provided in Financial Terms.htm*

[14]Ibid.

Figure 3.5. Rainfall in Baluchistan.



Of the entire area of Baluchistan (34.72 million ha), 58.6 percent is non-arable, forests cover 5 percent, 6.5 percent is lying fallow, and the 'net sown' area is only 4.8 percent (1.528 million ha). The area classified as 'culturable waste' (waterlogged, saline, or un-irrigated for 2-3 years, but potentially reclaimable) amounts to 25.1 percent of the total.[15] Table 3.1 shows Baluchistan's water availability as of October 1999[16]: It is very clear from the table that flood water amounts greatly exceed those of perennial water supplies.

According to the "Social and Economic Development Ranking of Districts of Pakistan"[17], of the 25 districts in Baluchistan only one (Quetta) is ranked as high in both social sector and economic development; 3 (Sibi, Ziarat and Lasbela) are ranked high in economic but low in social sector development; and the remaining 21 of Baluchistan's Districts are ranked as low in both economic and social sector development (Ibid 38). Ninety-two percent of the population of Baluchistan reside in districts categorized by low economic and social development (Ibid 38). "The Government of Baluchistan had declared 22 out of 26 districts calamity-stricken due to the prevailing drought situation" (Qazi). The Baluchistan Board of Revenue figures for the year 2000 indicates how devastating the province-wide effects of the drought were, then:

[15]Cited from Agricultural Statistics of Baluchistan, 1996-97, in "Brief on Development Activities of Irrigation and Power Department".

[16]Brief on Development Activities of Irrigation and Power Department, 2002, citing the "Baluchistan Conservation Strategy 1999."

[17]Social Policy and Development Center, 1998.

- no crops could be grown on 95,506 hectares of land
- wheat sown on 17,200 hectares produced no crop at all
- 60 percent of range lands produced nothing
- 10 million animals (mostly sheep and goats) died
- 250,000 livestock farmers were rendered destitute

The problem in southern Baluchistan is summarized by 80-year-old Haji Ghulam Hussain who said: "I and my forefathers have always lived here. We have heard from our elders that about 200 years ago there was a drought like this. But that one lasted 2-3 years. This is the worst in our lives. There has been no rain for the last 4-5 years after the 1998 floods. The livestock has been diminished by disease. I used to have 400 goats and 50 cows. Now there are 40 goats and one cow. Now, we spend our time cutting down and selling trees. We use the money to buy items for daily use. We used to be able to walk through this area and there were so many trees that we could not see the sun. Now, there are very few trees: many are dead and very few have green branches. The Sanghai forest is now ended. People are cutting drying trees for sustaining their lives. The drought has broken the backbone of our life. We used to sell fodder, vegetables and other crops in Turbat; now, we buy fodder from the rich people near Turbat who have installed tube-wells. I think there is a great need to construct storage dams. This will solve our problem."

Figures 3.6 and 3.7 make the effects of drought evident, indicating the severity in relation to both subsistence and cash crop yields including wheat, and dates.

The situation in 2002 was even worse, as there has been no substantial rainfall since the data in the figures were published. The current drought has devastated entire eco-systems as water supplies for human use, agriculture, livestock, wildlife and vegetation receded or vanished altogether. By all accounts, the amount of available groundwater in Baluchistan is decreasing every year. According to one source, "In Baluchistan underground aquifers are dropping at 3.5 meters annually and will be extinguished in 15 years"[18]. Another source claims that the rate of depletion is accelerating: "from 0.75 feet per year prior to 1989" to the present rate of 3 to 5 feet annually.[19]

Groundwater levels are being reduced at an increasing rate: " … in the decade from 1983 to 1993, the amount of potential groundwater in Baluchistan decreased from 936 million cubic meters per year to 619 million cubic meters per year". The same source says that "depletion of groundwater estimates for the period 1989-96 indicates a continuous decline of [the] water table from 0.2 to 3.5 meters per year."

A number of the pathogens that flourish in a drought - for example, when animal corpses decay on the surface or when they contaminate water supplies - have been identified in Baluchistan. There is no comprehensive data on the level of diseases associated with poverty (TB, for instance), or those related to poor sanitation and the lack of potable water. However, sources[20] note that some life-threatening viral diseases, such as viral hepatitis and, alarmingly, Crimean-Congo haemorragic fever have also broken out in some of the drought-affected areas of Baluchistan.

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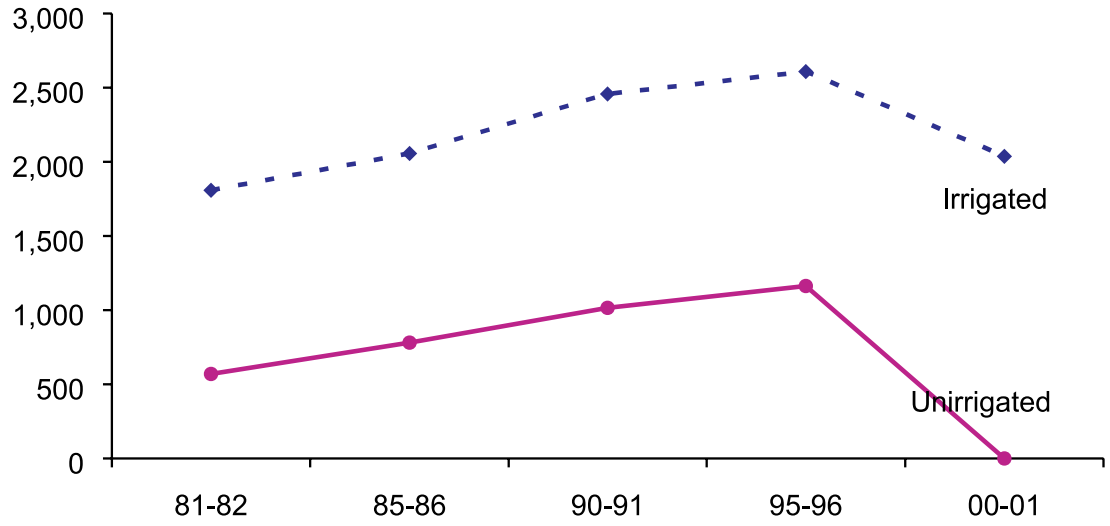
[18]PAKISTAN 12/10/02 and Irrigation Dept. Baluchistan, 2001.

[19]M.E. Khan, The News, Internet Edition, Wednesday July 24, 2002.

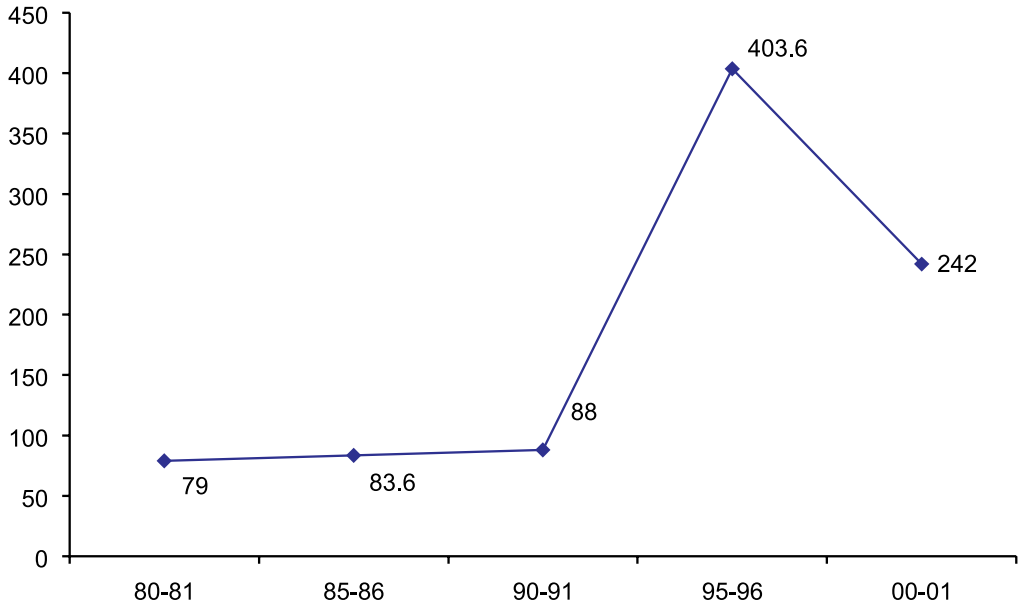
[20]Non-Food Assessment of Drought: Baluchistan and Sindh.

Figure 3.6. Wheat by mode of irrigation (kg/ha) in Baluchistan.



Source: Agricultural statistics of Pakistan 2000–2001, table 5.

Figure 3.7. Date production, Baluchistan ('000 tons).



Source: Agricultural statistics of Pakistan, 2000-2001, table 56.

Nutritional levels of poor men, women and children are inadequate in normal times: drought reduces the availability of food and compromises on its quality. Maternal and infant mortality and morbidity rates rise, as do stunting and wastage. The effects of diseases which are not otherwise life threatening are intensified by malnutrition. A study by experts from the United Nations Development Program (UNDP), carried out in April 2001, found that some 36 percent of the people they surveyed were suffering from malnutrition, as measured by Body Mass Index (BMI) figures. This figure is all the more dismal, as it is stated to be 'no worse than the national average'. This study also notes that the absence of data, and the inability to correlate co-existent factors, such as drought and poverty, makes analysis difficult.

TRADITIONAL WATER HARVESTING TECHNOLOGIES: THE KAREZ

The karez is the most ancient and indigenous source of irrigation in Baluchistan (Wilson 2000). The karez is a traditional, egalitarian system of water, land and labor distribution and management. A karez consists of a series of hand-dug wells and tunnels that collect rain and ground water and discharge it onto farmers' fields (see figure 3.8). In an area entirely dependent on rainwater, and with very little capacity for surface-level water harvesting and storage, the karez is the primary water-harvesting mechanism available to the poor and non-poor, alike.

In 1996-97, karez irrigation accounted for nine percent (78,550 ha) of all irrigated land in Baluchistan. This figure is a reduction of 62 percent from the 1971-72 figure of 208,000 ha (43%).

A key advantage of the karez is that it delivers water year-round, even during years when rainfall is below average. According to some of the residents of Turbat, where the study was conducted, when the current drought began the karez continued to deliver enough water to meet people's needs for about two years. Clearly, there are limits to this capacity, but the karez offers a far more conservation-focused method than the tube-wells which contribute to lowering the water table, encourage wasteful water use and operate at the expense of the poor, in that they reduce the amount of water available to the karez.

The market value of the land associated with the karez depends on the amount of water available and the fertility of the land. The land is subdivided into parallel plots called *hangams*. One hangam is the amount of land that can be irrigated by the karez in 12 hours. A hangam may be sub-divided amongst a number of partners, who will then share the water accordingly. Figure 3.9 shows the distribution of land irrigated by the karez outflow.

Ordinarily it takes 2-3 hours per week to clean the uncovered watercourse. A karez is cleaned every 2-3 months, with each partner contributing cash for workers' wages according to his/her karez water share.

Figure 3.8. The Karez system.

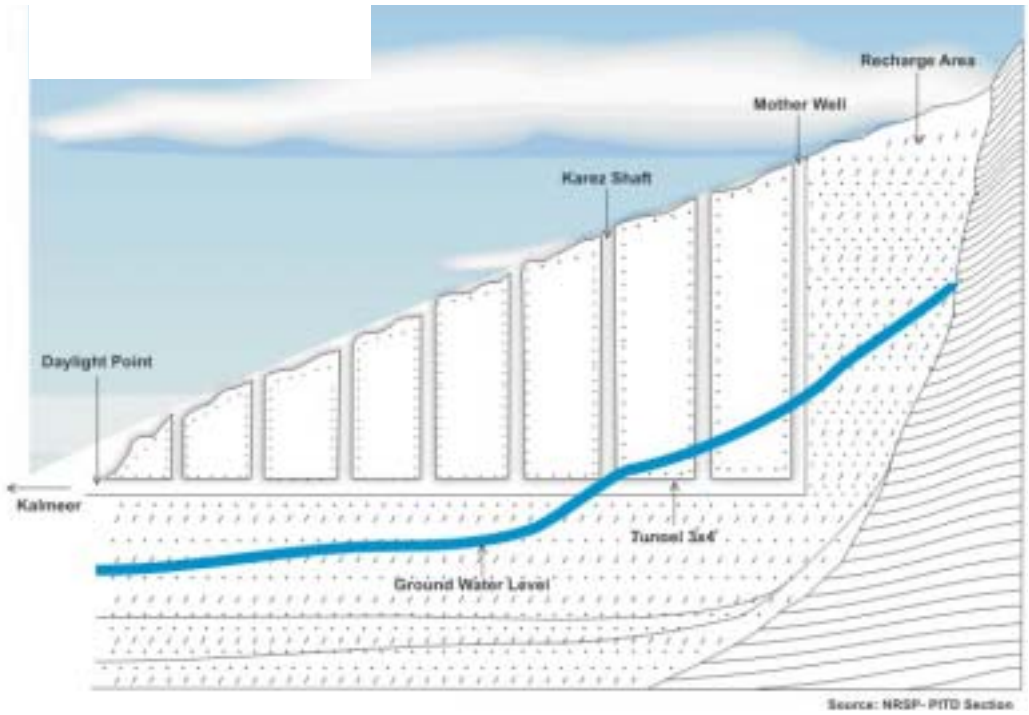
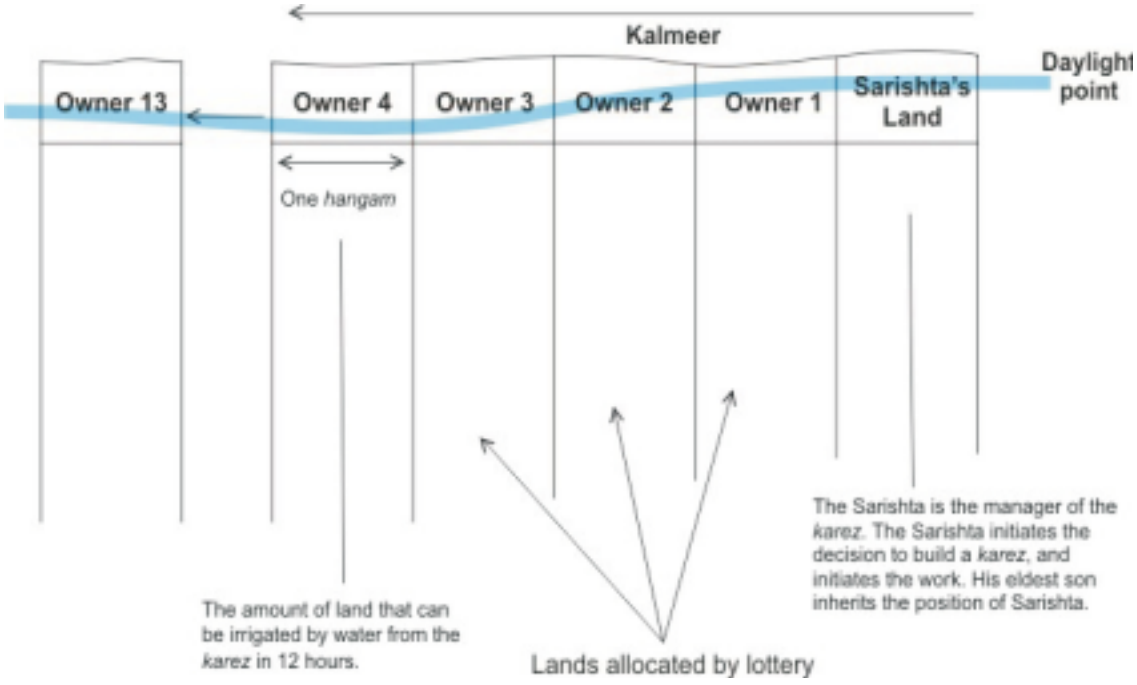


Figure 3.9. Land division in a karez system.



The land closest to the "daylight point" is owned by the *Sarishta* (manager) and the remainder is divided by lottery. The office of sarishta is held by the man who organizes villagers to complete the arduous task of building and maintaining a karez (see box 1*)*.

Box 1. Karez Irrigation in Baluchistan

Mr. Abdul Rehman, 90, is a valued source of knowledge on the karez and had this to say about their operation: "Our Karez is more than 400-years old. When a new Karez is to be dug, local, knowledgeable people assess the direction on the basis of the amount of land to be cultivated, the elevation of the nearby mountains and the direction of water flow in the streams. A well is dug at the centre of the proposed course. If we find water we start digging more wells upward towards the hills and down towards the fields. Normally it takes 2-3 years to dig a karez. For a new karez, we seek approval from the AC/DC or concerned authorities.

There are usually 80-100 partners on each karez. Every partner has a specific amount of land and water for irrigation. Usually, a sarishta is also the head of the village, biradri or tribe. So, he is relatively better-off in terms of financial position as well as his moral and political positions. If the karez partners are not satisfied with his performance, they can replace him. However, based on his (and his father's forefathers') services for the karez, he enjoys half the facilities. He does not pay cash and does labor for half hangam water.

There has been a change in the role of a sarishta. Previously, he was a very important person who was also involved in resolving social and political conflicts. Now, he is considered important only for karez work. Previously, he could fine anyone who did not work on the karez. This fine was usually in kind, not in cash. For example, if a partner did not participate in karez work, he had to pay some portion of his date production. Previously, people were more interested in karez work. Now, due to changes in life's facilities, they think it is very hard work. Previously, people started karez work early in the morning and ended the day after sunset. Now … the daily working hours have been reduced from more than 12 to less than 8.

Wilson (2002), describes the spread of the karez, called a *qanat* in North Africa where they originated, westward to Spain and the New World, and eastward to Iran, Afghanistan and Baluchistan. He notes that the problems currently facing Southwest Asia have recurred throughout history. With sufficient rains, water delivered through the karez has provided prosperity, through agriculture, livestock and trade, to large and stable populations. However, throughout history, the over-use of water, coupled with periodic droughts, has sometimes reduced economies and populations to almost nothing. It is tempting to think that responses to the current drought will result in different outcomes, but there is no guarantee that this will be the case.

The karez warrants attention because it has provided sustained supplies of water to communities for hundreds of years. The focal argument of the case study is that this traditional, community-based method of harvesting, transporting and utilizing water should be restored to its full functionality. Although karez restoration is not a panacea, it offers the best chance of restoring

economically marginalised communities to a status in which livelihood sustainability can be achieved and future vulnerabilities reduced. The question is how to ensure that the karez is restored effectively and how to ensure that the karez is integrated into a comprehensive plan of drought mitigation and prevention.

Despite the perennially arid conditions, and despite the fact that only 5-6 percent of the land in the area is arable, the deposits of alluvial soil irrigated by the output from the karez are capable of producing high yields, if sufficient water is available. Per hectare production of many crops equals or exceeds that in canal-irrigated areas in other parts of Pakistan. This is the case for staple crops such as dates, rice, sorghum, pulses, onions, garlic and some vegetables, as well as grapes and pomegranates (NRSP Turbat Annual Report 2001). The date palms that are capable of producing ten tons per hectare in good conditions could also form the basis of a revitalized economy, if sufficient water was available (Ibid). However, the drought has severely damaged even the hardy date palms, as shown by the survey described below.

THE CASE STUDY SETTING (SOUTHWESTERN BALUCHISTAN)

Study Site

In order to evaluate the role of karez irrigation as a response mechanism to water scarcity in general and drought conditions in Baluchistan in particular, Turbat, was selected as a case study area. The study aims to assess the role of traditional karez system in rehabilitating and restoring sustainable economies and communities in southwestern Baluchistan.

Turbat ranks 86th out of 94 districts in economic development in the country, according to the Social and Economic Development Ranking of Districts in Pakistan, and ranks 92nd in terms of social sector activities[21]. Thus, it is one of the most under-developed districts, and has suffered greatly from drought, as the case study shows. The arid climate, harsh terrain and lack of transportation and communication infrastructure mean that life can be difficult here at the best of times. The word *Turbat* means 'grave', an eloquent testimony to the difficulties of sustaining life, here. Temperatures can reach 50 degrees centigrade in summer. The average annual rainfall "varies from 50 to 150 mm in southern and western Baluchistan and the annual potential evapo-transpiration exceeds rainfall throughout the year, in many basins or sub-basins"[22] (Board of Revenue, Baluchistan).

Turbat is poorly linked to other major cities and towns. Many services, including health and education services, are unavailable or available only intermittently. These factors contribute to the difficulties of establishing long-term improvements, and make it difficult to plan and deliver relief. Outside a few urban and peri-urban areas, there is almost no employment that is not land or resource-based. Literacy rates, especially women's, are extremely low.

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[21]Social and Economic Development Ranking of Districts of Pakistan. Social Policy and Development Centre, Karachi, Table 4.

[22]Drought-hit communities of Mekran Division, Baluchistan: Brief on Crisis Situation in the Drought-hit Areas. Commissioner, Mekran Division, May 2000.

The economy of Turbat depends on trade, agriculture and livestock. Some 80 percent of the population of Turbat depend on farming and livestock. Remittances and savings from money earned while working abroad are also important. Trade across the Iranian border flourished for many years, and made some families prosperous. However, this means of livelihood vanished when the events of September 2001 led to the border being closed.

Foreign remittances are a significant source of income. In the 1960s to 80s, many workers, mainly men, from Turbat and southern Baluchistan sought employment in the Gulf States. At one time, up to 30 percent of households had at least one family member working in the Gulf. These men sent home their wages and many bought a share in a karez upon return. A few invested in tube-wells, but very few could afford to do this, and the karez met their needs for irrigation water. Some new karez were built with these earnings but most of the investment was in karez extension. A flood devastated Mekran division (adjacent to Turbat) in 1998, with the total damage (lives lost, houses destroyed, agricultural losses) estimated at Rs 103 million, and communities are even now coping with the after-effects of the floods and severe drought. The floods caused extensive damage to the karez, filling the tunnels and wells with silt and debris. Economic distinctions determined the kinds of responses made to the drought: the relatively affluent were able to clean and repair their karez quickly, and restore the supply of water. Deciding against collective efforts to rehabilitate the karez, some families installed tube-wells, increasing the number already in existence. Thus, the floods created a widespread demand for massive rehabilitation of the karez, but the majority of the villagers – most of whom were poor - were unable to muster the economic resources for this. Some were able to buy water from the tube-well owners, which made them reluctant to rehabilitate their karez. Some of the poor expected government grants for karez rehabilitation, but these did not materialize.

Case Study Methods

A household survey was conducted, covering 108 households in 10 villages. All respondents belonged to Community Organisations (COs) of a national NGO, the National Rural Support Program (NRSP). In addition to the household survey, information was collected through interviews with a small number of District Government officials, a former Minister of Agriculture, the District Nazim (Chief) and a number of Councillors and community members. Several sarishtas, karez workers and users, who could recall the time when the karez were functioning at full capacity, were also interviewed. In addition, interviews were held with water-based enterpreneurs, water vendors, and water supply officials. In addition to the household survey, participatory poverty assessments and rapid rural appraisal methods were used. Focus group discussions were also held. Women were asked to explain the specific impacts they have faced because of the drought, but only a small number did so.

Most respondents live, as one would expect, in extended families. The extended family constitutes the social safety net for most people. Average family size is 15. Only one of the households had no male member. Of the 108 households surveyed, 107 are landowners, owning an average of 12 *dagars* (1 dagar = approximately ½ acre[23]) of land. Land-holding size ranges from 1- 64 dagars. 72 families own land in one piece, while the fields of 32 households are spread out. 68 families had inherited their land while 39 had purchased it.

[23]A dagar is not a fixed amount of land; its size varies according to local criteria of land availability and crop yields.

STUDY RESULTS

As noted above, all 107 respondents included in the survey are members of a karez, i.e., they own a share of the land irrigated by a karez; they have contributed cash and/or labor to building or extending a karez, and they depend on the output of karez-irrigated agriculture for a majority of their household income and subsistence. The average reported age of the karez is 219 years, although one is thought to be 500-years-old. The average length of the karez owned by the households surveyed is 4 km. (range: 1-9 km). The average depth of the mother well is 54 feet (range: 9 - 96 feet). Well depth is measured by a man's height (approximately six feet).

In terms of contributions, 67 percent of the households have contributed cash to karez building/ maintenance or extension, with an average expenditure of Rs 4,284 per household (range Rs 300 to Rs 30,000). Only 36 percent of households report contributing labor to *karez* maintenance. This is partly because the above-ground labor is arduous, and the underground labor required is quite specialized.

The average value attributed to the land, by the owners, is Rs 7,48,250 (80 responses), although these values are not necessarily congruent with market prices, in the absence of a viable market. The fact that only 4 percent of families reported that they had sold land or water rights in the last 5 years also indicates the lack of a viable market.

In terms of efficacy of the karez system as a reliable source of water supply, 83 percent of the respondents reported that there is some water in the wells, although 55 percent said there is far less water than they require. In terms of technology, 87 percent of households report using only karez water for flood irrigation: i.e., they utilize no other technologies for carrying or distributing karez water to the fields. However, the rankings of drought differed widely. About 72 percent respondents ranked this drought as "the worst ever" and another 25 ranked it as "very bad."

Families with crop production as the mainstay of their livelihood, reported a significant reduction in crop yields, loss of livestock, widespread loss of date palm plants, and in particular large reductions in date harvests, despite the hardy and drought-resistant character of the date species grown. Date farmers had been inflicted with substantial losses to their investments both due to the death of plants and yield losses, and this has clearly affected daily wage laborers dependent on the date enterprises. Insufficient water supplies from the karez system are to blame. Similarly, production of other fruits and vegetables has been affected seriously. This has even forced some households to sell land to buy water, invest in new deep wells, turbine pumps, and extend and rehabilitate karez, but these measures have not solved the long-term problem, and they are only available to the relatively well-off. Households, whose primary source of income is employment, and whose agricultural incomes are only supplemental, have to some extent been resilient to drought-related economic stress, which points to the importance of income diversification and employment creation in the non-agricultural sector for the rural poor.

Families dependent mainly on livestock ranching echo grave concerns to their livelihoods due to livestock death, loss of animal products such as milk, wool, mohair, and goat hair, lack of forage, need for supplementary feeding, and rising forage prices and non-availability of fodder in town markets. Further, livestock had been diminished by disease. This forced many desperate families to cull and downsize their herds. At present, the number of livestock owned is very low, compared with the potential for livestock production under the right conditions. Families reported owning an average of 13 animals (99% of respondents), a majority of them sheep and goats. Normally, livestock serve as a buffer stock and help mitigate income loss in crops, but the situation is reversed now. Livestock are a net liability, due to lack of forage and deterioration of rangeland and water supplies. Some herders and farming families have resorted to cutting down permanent forest plantations and

selling trees to help support their subsistence income and livelihood needs. This clearly points to unsustainable and degrading practices in the management of communal rangeland and forest resources.

The impending drought crisis and ensuing reduction in water supplies from the karez have taken their toll on household incomes, as can be gleaned from the impacts on crop, fruits, and livestock productivity. The overall impact is a fall in household income. Table 3.2 gives source-wise household incomes. Remittances are a major source of income, and about one-third of households receive remittances.

Table 3.2. Livelihood sources and average household incomes.

Income source	No. of households	Percent of household deriving income per response	Average income per response (Rs)
Crops (excluding dates) per season)	40	37.03	10,350
Date production (per season)	70	64.82	26,403
Daily wages (per month)	14	12.96	3,021
Trading (per month)	9	8.33	3,933
Service/employment (per month)	36	33.33	13,210
Other sources (annual)	34	31.50	133,265

Among horticultural products, dates are the most valuable item produced by the farmers in the survey, providing the highest yields and the highest income per *maund* (40 Kg). Over 98 percent of the households in the survey own date palms, owning an average of 278 trees (range = 20-2000 trees). One household owning 2,000 trees is facing economic ruin, as drought has lasted for 7 years and their date income has been reduced to zero. In 1998, each of their trees yielded 50 maunds (2,000 Kg) of dates but in 2002 they yielded nothing.

Overall, 9 percent of the households reported that their date palms produced nothing at all in 2002. Decapitalization of land values and negative returns to investments are therefore, self- evident. Date production has both consumption and cash value. Amongst 105 households, an average of 48 maunds were sold and 16 maunds consumed. The average annual income (64.8 % of the households reporting) from dates was Rs 26,403, with the range of income from Rs 800 to Rs 300,000. Since dates are an extremely important cash crop in Turbat, this is particularly significant, and has negative implications for restoring the area's productivity. Some of the very poor have been reduced to eating *koosh*, the inner edible portion of the date palm. The koosh from one tree provides a single meal for half-a-dozen people. The average value of a date palm two to three years ago was Rs 1,000, but now there is no market for the wood, and the trees are dying.

Dates are not the only crop affected, rather, water scarcity and drought has reduced the yield of every crop, in some cases to almost nothing, as table 3.3 shows. These findings are congruent with Qazi's study of central Baluchistan, which found that: "….all of the respondents registered a decline in their standards of livelihood during this period [and] all of them associated this decline with increasing scarcity of water. All the respondents recalled 1998 as a bad year and all of them attributed it to less rainfall in that year. Years 1999 and 2000 were declared bad years by all the respondents due to a total absence of rains and in 80 percent of the villages, the drop in ground water level was also stated as an indicator of water scarcity…. In 90 percent of the respondent villages, a sharp decrease in cropped area occurred in the year 1998 while 10 percent of the villages reported no crop at all during that year. Respondents from 28 percent of villages reported a further

decrease in cropped area and people from 72 percent of the villages reported no crop in 1999. In the year 2000, all the villages reported no annual crop production because of failure of rainfall".

Table 3.3. Impact of drought on yield of major crops.

Item	Average crop yields reported		
	1998	2002	Decrease
Dates (*maunds*)	77	34	56%
Wheat (*maunds*)	30	3	90%
Fodder (*dagars*)	92	75	18%
Pulses (*maunds*)	11	1	91%
Vegetables (*maunds*)	19	2	89%

Poverty and Vulnerability

Our survey results show that the average monthly household income is Rs 6,210, and given an average family size of 15, this works out to around Rs 515 per capita. Using a poverty line of Rs 731 per capita per month, it transpires that the average household lives below the poverty line, and assuming normal distribution, it implies that most people live in extreme poverty with their mean income below 50 percent of the poverty line.

According to many respondents, Turbat was formerly a place where people trusted each other and crimes were almost unheard of. Now, however, social stresses resulting from the drought are increasing: incidents of theft, robbery and smuggling of food and drugs are reported. One example is the theft of wood; some people are cutting down the remaining trees to sell the wood.

It is evident from the Turbat survey and from other sources that a new category of poor people has been created by the drought and consequent failure of the karez. Although some of the people surveyed were at one time relatively secure financially, many are now reduced almost to destitution after five years of unremitting drought. Some people, especially the elderly and the chronically poor, are now forced to beg for food.

Qazi reports the sale of assets as "a frequent phenomenon during the last three years to generate cash to meet urgent household needs", noting that " … jewellery, watches, fire arms and domestic items, and productive assets such as land, livestock, forest trees, agricultural implements, farm machinery, sewing machines, etc.," have been sold to meet household needs.

Those who were able to have invested money and other resources – some saved, others borrowed - in attempts to provide water for agricultural, livestock and household use, but many have passed the limits of those resources, and their insurance mechanisms and coping strategies have exhausted. Their land is exhausted, and soils have been rendered infertile. Their livestock herds are reduced to almost nothing. All these have made the karez, and entire communities increasingly vulnerable to risk. Even when the rains return, they will have no resources with which to build up their asset bases and get started. Families will 'recover' to different degrees from the loss of productive members.

For the chronically poor, it will take several years of hard work to restore household finances to sustainable levels and to re-build economic and human resources such as livestock and agricultural assets, and to finally, move out of poverty and vulnerability.

Health Effects

The after-effects of illness suffered as a result of drought can also be very costly. Both women and men consider running water better for health than standing water. The water flowing in the karez is filtered through the soil, which is thought to kill bacteria. Water standing in a well is thought to cause health problems. For example, many people in village Dagari Kahan have kidney problems, which they attribute to well water. Similarly, water scarcity is creating sanitation problems, and affecting personal hygiene. In the words of a man in Turbat: "The rich wash their vehicles with sweet water but water is not available for the poor to drink. Are we not human beings? What are the facilities for poor? Nothing! Look at my clothes, I have not taken a bath for the last month and many times we do not wash our face. We are also human beings. We also need basic necessities."

Effects on Women

Women in Turbat, like most in the rest of Baluchistan, play a central, albeit indirect, role in home economics, although their work remains unacknowledged. Therefore, they have been equally affected by water scarcity. Lack of food, poor nutrition and poor sanitation typically result in decreased resistance to diseases. Women in Turbat used water from the karez for every purpose: drinking, bathing, washing clothes and so on. They had access day or night to the karez water that flowed through their lands. It was counter to their privacy and dignity to use water from the tube wells. With the drought, however, it is no longer possible to rely on karez water. Some of the tube-well owners ask for free labor in exchange for water, and even harass or abuse the women verbally, which has caused conflict between families.

Other problems include increased livelihood burden on women due to migration of spouses outside for income supplementation, long waiting time at communal/private water sources (due to low yields), enormous burden on time and physical capacities of women in carrying daily household water supplies, disability and death during water collection (drowning of children in well), lack of financial resources to buy drinking water, and poor quality and strictly limited availability (15 to 20 minutes per day) of water supplies, where there is a connection or communal stand post. Strengthening government response mechanism, dam construction, digging more communal wells/ karez for sustainable water supplies[24], community management of water resources, and in-house water connections are some of mitigation measures called for by the women respondents, we were able to interview[25].

The need to carry water, wherever it is from, has increased women's labor. When a karez was in good order, they did not have to carry water for bathing and washing clothes. Nor did they carry water for their livestock. Now, they must carry every drop of water that comes into the house. On an average, a woman must carry more than 200 liters of water every day, which creates enormous burden on her time and physical capacities.

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[24]Some of the hand-dug wells are extremely deep and women report great difficulty in drawing water from as far as 200 feet below the surface. The wells have had the positive effect of saving some women the indignity of being accosted by tube-well owners, which many women reported, and of saving women the arduous journey in search of water every day. However, it requires great expenditure of energy to lift the water. Especially when women are weakened by pregnancy or by lack of food, drawing water exerts a tremendous physical burden on them.

[25]Such opportunities are strictly limited, due to social norms and tribal culture of the society. Women, here, are reluctant to be interviewed even by other women.

Qazi reports that "In 10 villages in Qila Saifullah … women reported an increase in the incidence of miscarriage because of physical weakness and excessive domestic labor … around 107 such cases were recorded during the last three years … Around 92 cases of miscarriage due to similar conditions were reported in 7 villages in Mastung district. …"

When asked to comment on water problems, especially the lack of water, women made the following stark and eloquent statements:

- We have no water. We are in great difficulty. The livestock are dying. We women are totally responsible for fetching water from a well more than 200 feet deep, located about half a kilometer from our houses.

- Two of our girls fell down while they were fetching water: one of them died while the other has become a permanent patient: now, she cannot walk.

- We are poor women and in great difficulties because of water unavailability. The supply water comes after 15 days for only 10-20 minutes and the quality is poor. Some private tanker owners sell water but we cannot buy water from them. From my house, I am the only one responsible for fetching water as my daughters are grown up and I cannot send them for fetching water because in our system someone may accuse the girls of immoral behavior with men.

- We women also want respect and dignity but we have no option except to fetch water. In our society, even if men do nothing the whole day and sit in the house, they do not fetch water. It takes more than one hour to bring about 10 liters of water. We have to make 5 or more journeys every day. Is this not a difficulty and a problem?

- I think it is the duty of the government to provide water to all. The Government is now asking for community management. I think that if the NRSP staff mobilises the community for the operation and maintenance of the scheme, then there is a possibility of water provision to all.

- We are poor people. There is no water. Some water is present in the dam, but the Government does not give us this water. Where can the poor go? Should they die?

- The government officials sell the drinkable water and give salty water to us. Forty or fifty years ago there was no water problem. There were enough good wells to supply our needs. These wells are dry now. The government is now constructing a dam. However, the need now is to construct new wells for sustainable water supply.

- Wherever, we go, they say 'no water'. Government officials do not treat women and children well. The women are busy all day fetching water and can't do anything else. We have no electricity, no water, no food. When the poor women come to fetch water, the officials abuse and push them away.

- Previously, water was available in the houses through a piped water supply scheme. Now, women are compelled to go out of their homes by 9 am to fetch water. They don't come back until after 3. Then they cook and do all the other household work. The men are always out of the house and in their absence, the women are responsible for looking after the houses. Some men are away for weeks and months at a time, looking for work.

Box 2 presents some selected voices from the community which give a graphical account of the impact of drought and the significance of the Karez for rural livelihoods in Turbat in particular, and Baluchistan in general:

Box 2. Voices of the Karez Irrigated Communities.

"We have lost 100 (date) trees out of 600, since the drought began. Our estimated financial losses are close to Rs 300,000 in the last year. The extremely old karez does not have enough water to meet our needs and needs to be extended. …(date farmer). And:

> "the drought has broken the backbone of our life. We used to sell fodder, vegetables and other crops in Turbat. Now, we buy fodder from the rich people, who have installed tube wells. I think there is great need to construct storage dams. This will solve our problem", adds another farmer. And about the water supplies:
>
> "….we get drinking water from a well that is 150 feet deep. A 180-feet deep well is being dug, but the water is not suitable for drinking. The pond, which we used to use for washing clothes and bathing, used to be full all year round. Now, it is completely dry", adds a community leader.

Sarishta (head-man) of a century-old karez, said "We have always grown enough wheat, rice, dates and fodder, but in the last five years there has been no rain. There must be water for life – both for human and animals. Agricultural productivity depends on water. The more water, the more crops we can grow. The karez water is lowering. We are poor. We have nothing at our home. Our income is very low. If our karez is rehabilitated, the water supply will increase."

Karez rehabilitation is better than installing tubewells. Cropping with tube wells is very costly. The expenditure for karez rehabilitation … is less than for the tube wells. The poor cannot afford tubewell operation and maintenance expenditure such as fuel and repairing. With the karez, the poor get free water day and night. They put some labor, which they can do with their own capacity, except the rehabilitation. The poor can do karez cleaning but not extension. Skilled persons are required for rehabilitation and extension as making tunnels is a highly skilled process.

Risk-coping mechanisms

Households have responded to the drought variously, and attempted to marshal financial resources, in different ways, according to their financial and social abilities. For example, 65 percent of the respondents have installed supplemental water supplies, 23 percent have installed tube-wells, at an average cost of Rs 41,000; 11 percent have installed electric motors on existing wells to draw water deeper from the ground, at an average cost of Rs 4,827; and 30 percent have dug new wells, with an average cost of Rs 300, for household and animal use.

Key mechanisms adopted by the karez communities for coping with water scarcity include installation of water pumps; purchase of water supplies; migration in search of work (12%); rehabilitation of flood-damaged karez*;* actual contribution or willingness to contribute labor and financial resources, and subsequent management of the karez; rehabilitation of existing wells, and digging of new deeper wells; borrowing from institutional and non-institutional lenders, where available, and demand for government support for karez and well rehabilitation, construction of new dams and conveyance system for available water supplies.

Key responses from the government[26] and NGOs include (some of the initiatives mentioned below are currently being undertaken): (1) construction of irrigation infrastructure to enable Baluchistan to utilize its share from the Indus River, including the construction of (i) Rabi Canal, with a command area of 50,000 acres, in Naseerabad area, (ii) Kachhi Canal, to bring 70,000 acres of barren land under irrigation and (iii) Mirani Dam project, to bring an additional 35,000 acres under irrigated agriculture; (2) development and extension of trickle irrigation system in selected areas of the province; (3) subsidy for the installation of trickle irrigation systems, for interested farmers, which can save 60 to 70 percent water; (4) Subsidy[27] to private vendors and potable water suppliers to enhance the poor's access to drinking water; (5) Drought Emergency Recovery Assistance, a federal government initiative, from ADB/World Bank funds (US$45 million for Baluchistan), allocated to 12 districts badly affected by drought in the province, and (6) mobilizing the community's financial, managerial, and organizational resources for the rehabilitation and extension of existing karez systems, digging of new wells, and initiate thinking for the construction of new karez, as a sustainable, low-cost, and dependable source of water, by NGOs.

DEVISING INTEGRATED RESPONSES TO DROUGHT: DOING MORE WITH LESS

The point has been made in numerous studies that drought and its related effects have an impact on every aspect of the natural and social environment. It is equally clear that drought requires integrated responses that account for as many aspects of the situation, as feasible. Although expertise is necessarily discipline-specific, focusing on health, agriculture, technologies, and on poverty itself, the expertise must be brought into a common forum so that the effects of drought can be addressed, and comprehensive responses implemented. Each of these complex issues, and the interactions between them, must be taken into account in a comprehensive response to drought.

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[26]Extracted from "Water resources development projects and program of mitigating drought effects in Baluchistan." http://pakistan.lead.org

[27]The Government pays Rs 60 per cubic meter, but the people pay only Rs 2 per container. The Government provides Rs 60 per cubic meter to tanker owners for water supply to the poor. That is why they are charging only Rs 2; otherwise, they could charge more than Rs 5 per container.

Nurturing community support and mobilizing community's organizational, financial, and human resources for integrated management of existing water and other natural resources must form the core of any drought mitigation strategy. To be specific, karez rehabilitation should be one of the key foci of this strategy, because, in the words of the community .."karez means life to the people, it is agriculture, it is survival,… but people are very poor, they can't afford the money to rehabilitate the karez themselves, shortage of skilled labor is another constraint….(as a result) in Kech, out of 360 karez, about 60 percent are defunct…., karez water is lowering, people are poor, they have nothing at their homes, incomes are very low,… …the expenditure for karez rehabilitation is less than for tube-wells.. operation and maintenance expenditure, such as fuel and repairs… with karez, people get free water day and night… if karez is rehabilitated, the water supply will increase, [life will come back]." There is a ray of hope, however, as the survey respondents showed a strong willingness to contribute rehabilitation labor and undertake responsibility for subsequent operation and maintenance of their karez.

It is well understood that rehabilitating the karez is a significant means of restoring the water supply to communities, once rainfall returns to normal. An important consideration in karez rehabilitation is that the infrastructure, and decisions concerning its upkeep and the allocation of water and land, remains in the hands of karez members. This essentially integrates the social and economic systems with each other, which helps to ensure that sustainable commitments are made and maintained.

This is not the only action necessary, but it should be one of the focal points; the others being the construction of large-scale dams and water storage bunds. Where earthen dams exist, and where large-scale dams will be constructed (i.e., the Mirani Dam on the Dasht River), the karez will serve as a means of delivering water to the villages.

Presently, close to 400 karez supply irrigation water to almost 40 percent of the cultivated area in Turbat. During the last decade nearly 200 karez have been restored (i.e., new wells dug, and channels deepened and lengthened) by Government departments, the National Rural Support Program and other NGOs working in the area.

As of July 2002, NRSP and its Community Organizations (COs) had rehabilitated 112 karez in Turbat, benefiting over 13,000 households. Funding for NRSP's efforts has come primarily from UNDP, the Pakistan Poverty Alleviation Fund, and contributions of labor and cash from the COs. The combined budget for the 112 karez was Rs 21.5 million. Of this, the COs contributed Rs 7.5 million, which is 35 percent of the total cost (NRSP-PPAF Annual Report 2002). The Government of Baluchistan is also engaged in karez reconstruction and rehabilitation. Karez rehabilitation is supplemented by the installation of hand-pumps, drinking water supply schemes and sanitation schemes.

The Government of Baluchistan has spent Rs 40 million extending and improving 100 karez in Baluchistan. The largest number of these, 23 in all, located in Turbat/Panjgur, were rehabilitated at a cost of Rs 8.28 million.[28] The Government has also recently built a number of water storage bunds which are linked to the karez system.[29]

[28]Irrigation Dep't. Government of Baluchistan.

[29]Mirani Dam Project Report, WAPDA, August 2001.

While every effort must be made to increase the efficiency of the karez rehabilitation process, the rehabilitation methods used at present are extremely time-consuming, as all work above and below ground is done with very basic implements and technologies. In the words of a karez laborer:…." It is very difficult to work inside. It becomes very difficult to breathe inside the tunnel. Normally we have three shifts and at least three men are required to work on each shift: one digs the tunnel, another collects the mud [from the tunnel], loads it in the basket and ties the basket to the rope. The third man pulls the bucket out of the well, empties it and sends the bucket back down. ….The worst thing is the oil smoke. An open pot like a chimney is put in the tunnel for lighting. But the smoke makes it hard to breathe."

The following is a set of strategic responses that must complement karez rehabilitation efforts to help protect the poor against drought, poverty, and food security.

- Integrated water conservation strategies must be devised, to enhance the benefits of available water supplies, and to optimize water use efficiency once the rainfall resumes. This should begin with the collection and storage of every drop of rainwater in household cisterns, wells and check dams. Reforestation to hold the soil in place and to generate humidity where a water supply does exist will also be necessary. Developing alternative methods of drawing water, perhaps including such innovations as solar rather than diesel or petrol pumps[30] will contribute to minimizing the amount of non-renewable fuels required to draw water.

- Research is needed on growing crops that do not require large amounts of water, can hold the soil in place and that would be appropriate for subsistence and marketing in southern Baluchistan. Some of the work done in the barani areas of Pakistan, for example, zero tillage technologies, and elsewhere in South Asia, for example, micro-irrigation technologies, could usefully be extrapolated for this purpose.

- Using water more efficiently is clearly necessary. One means to this end, that are relevant to the karez as well as to other domains, is, the introduction of water delivery mechanisms including "modern irrigation application techniques (trickle, sprinkle, etc.) that have the potential to improve water distribution and … efficiency."[31] The overarching point, as it relates to the karez, is that any new technology which has the potential to conserve supplies and increase outputs should be tailored to the karez-supplied irrigation. Methods of making such systems financially attractive to farmers, and available to the poorer farmers, will need to be devised and implemented.

- Water conservation i.e., maximising water usage and reducing water losses, must be the key to a stable and sustainable effort to ensure that the effects of future droughts are less devastating. The conservation of every water resource utilized for subsistence and cash cropping must be encouraged through public awareness campaigns, and through enlightened policies, that reward efforts to conserve water and impose negative sanctions on those who waste it.

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[29]A solar pump has been installed by NRSP staff in the Fateh Jang District of Punjab. Although these are expensive at present, it should be possible to lower the cost if a large-scale program is implemented.

[30]Comments on Draft Framework for National Water Policy Prepared by the Ministry of Water and Power, Government of Pakistan, April 2001, p.7.

All of these potential actions will require a skilful integration of social, scientific and technological research and action. Governmental commitment (i.e., 'political will', the commitment of resources, and good governance) is also critical. To put this in another way: the knowledge that, although, periods of drought vary in severity and frequency, water shortages are a recurrent feature in many parts of Pakistan, must be incorporated into all development and resource-use planning and policies.

Part of a long-term, integrated response, i.e., "management" in the widest and best sense, should include analysis of successful efforts to integrate social, economic, scientific and scholarly research in other parts of South Asia as well as in Pakistan itself.

It seems inevitable that the effects of water shortages will increase in the foreseeable future, because of the effects of at least 20 years of over-extraction for subsistence crops and livestock and industry, coupled with an increased demand to meet human needs. Projected increases in temperature due to global warming will also have an effect. It is also the case that each successive occurrence of drought makes it harder to respond in human, financial and political terms, to the next occurrence, as resources are diminished.

The need for an integrated response requires that local, regional, provincial and federal policies be integrated with - or at least be congruent with - each other. It also requires the optimizing of all water-use practices, including water harvesting and storage techniques and small and medium-scale irrigation mechanisms. Efforts to reduce water wastage and schemes for re-using water could also be integrated into mitigation efforts. Some of the initiatives devised by NGO's, including the National Rural Support Program, in educating farmers and household members on water conservation strategies will be useful here.

Climatic factors are clearly primary in a drought, but it is the case most often that accurate data is often not available, making both assessment of trends and accurate prediction of future events difficult. The need for accurate meteorological data, both local and regional, is critically important for understanding longitudinal climatic trends, and for predicting normal and abnormal rainfall patterns. The likely effects of changes in these long and short-term patterns can only follow from analysis of accurate data.

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Chapter 4

Water, Health and Poverty Linkages: A Case Study from Sri Lanka

Sarath Abayawardana and Intizar Hussain

INTRODUCTION

Water, health and poverty are closely linked. Health and poverty have a two-way relationship. Good health brings prosperity, and prosperity brings improvements in health. Conversely, poor health may create and perpetuate poverty and poverty may lead to poor health. Whatever the direction, water is at the center of this linkage. Water influences health through direct consumption as in drinking water, in sanitation, and by its use in household food and nutrition. Water also contributes to the livelihoods of the poor, because its a key input in agricultural and non-agricultural production processes and in the environment in which poor people live, and on which they depend. This chapter examines these linkages using the example of Sri Lanka. It develops a simplified conceptual framework to probe pathways and linkages between water, health and poverty and shows the utility of the framework as applied to Sri Lanka, using public domain data as well as results from various studies, particularly, those from the International Water Management Institute. Key lessons are highlighted in relation to social safety nets, the importance of considering groundwater in the development of the water policy, and the need for improved irrigation management, particularly as related to the interaction between irrigation water and domestic water in rural areas.

POVERTY IN SOUTH ASIA WITH A FOCUS ON SRI LANKA

Almost half of the world's 6 billion people live on US$2 a day and one-fifth of the world's population lives on less than US$1 a day, with around 44 percent of the world's poor people living in South Asia (World Bank 2000). Within South Asia itself, there is a significant variation in the incidence of poverty across countries. Available data on the incidence of poverty indicates that it is highest in Bangladesh and Nepal, followed by Pakistan (table 4.1).

By these measures, poverty in Sri Lanka is relatively low within the South Asian context. However, there are major anomalies between Sri Lanka's rural and urban sectors. While the urban incidence of poverty is far better than the rest of the region at 13 percent, the rural incidence of poverty is not so, and is comparable with other countries at about 29 percent. While the figures are not strictly comparable due to differences in reference years and definitions, they do give an indication. A generally accepted conclusion is that about 25 percent of the population in Sri Lanka live in poverty (measured in terms of household income and consumption), but that abject poverty or destitution exists in Sri Lanka though in small pockets.

Table 4.1. Incidence of poverty in South Asia.

Country	Population in poverty (%)			Year of reference
	Rural	Urban	Total	
Bangladesh	44.9	43.3	44.7	1999
Nepal	44.0	23.0	42.0	1996
Pakistan	22.4	36.3	32.2	1998-1999
India	27.1	23.6	26.1	1999-2000
Sri Lanka	28.7	13.4	26.7	1995-1996

Source: Key Indicators of Developing Asian and Pacific Countries, ADB (2002).

Since poverty rates are highest in the rural areas, and 85.3 percent[32] of Sri Lanka's population lives in rural areas (80% in rural villages, 5.3% in estates in the plantation sector), (World Bank 2000), poverty in Sri Lanka is largely a rural phenomenon. Table 4.2 provides measures and trends of poverty in the urban, rural and estate sectors (those in the estate sector are also considered as rural) (N. Gunatilleke 2000).

Table 4.2. Incidence, depth and severity of poverty in Sri Lanka by sector: 1985/1986, 1990/1991, and 1995/1996.

Sector	Reference poverty line : Rs 792 per person per month at 1995/1996 prices								
	1985/1986			1990/1991			1995/1996		
	IOP	DOP	SOP	IOP	DOP	SOP	IOP	DOP	SOP
Urban	18.4	4.4	1.6	15.0	3.4	1.2	14.7	3.0	0.9
Rural	35.6	8.9	3.2	22.0	4.5	1.4	27.1	5.8	1.9
Estate	20.5	3.9	1.3	12.4	2.1	0.6	24.9	4.9	1.6
Sri Lanka	30.9	7.6	2.8	19.9	4.1	1.3	25.2	5.4	1.7

Notes: IOP - Incidence of Poverty (Head Count), DOP - Depth of Poverty (Poverty Gap), SOP - Severity of Poverty (Squared Poverty Gap).
Source: Department of Census and Statistics, and World Bank, Sri Lanka; Poverty Assessment 1995.

Table 4.2 indicates that the incidence, depth and severity of poverty is highest in rural areas with poverty in rural villages and estates declining between 1986 and 1991 and increasing between 1991 and 1996. The increase in poverty in rural areas between 1991 and 1996 is attributed to the drought that prevailed during this period (World Bank 2000). The highest incidence of poverty was recorded in 1995/1996 among households deriving their income from agriculture. Slow per capita growth in agriculture (only 1% during 1990-96), major drought, contraction in the paddy sector; slow growth in rubber and mining sub-sectors, may have contributed to the higher poverty levels in the rural sector.

[32]*Source:* Extract from report of Census of Sri Lanka, 2001, Department of Census and Statistics.

Poverty in urban areas has declined continually between 1985 and 1996. For the whole of Sri Lanka, poverty declined up to 1990 and then increased substantially in 1996, but was still below the level of 1986. Thus, we can observe a cyclic pattern of poverty decline, increase and decline again. The current declining trend in poverty has continued after 1997.

There is a significant variation in the incidence of poverty across provinces in Sri Lanka. As shown in table 4.3, the incidence of poverty is high in Uva, followed by the North-Western province. The incidence of poverty is almost similar in Sabaragamuva and North-Central regions, estimated at a little over 31 percent. The Western region has the least incidence of poverty, estimated at around 14 percent in 1995 (using the lower poverty line), followed by the Southern and Central regions.

Table 4.3. Incidence of poverty in Sri Lanka by region.

Province	Poverty head count					
	Poverty line = Rs 791.67 per person per month			Poverty line = Rs 950.00 per person per month		
	1985	1990	1995	1985	1990	1995
Western	19.49	15.23	13.61	30.04	25.92	23.35
Central	30.11	23.49	27.89	45.64	37.88	42.90
Southern	39.24	23.73	26.84	53.37	38.64	41.38
North-western	33.78	18.03	33.87	48.50	31.00	52.38
North-Central	33.05	18.16	31.16	50.76	34.12	46.67
Uva	40.45	23.71	37.04	55.56	39.81	55.17
Sabaragamuwa	40.96	23.07	31.59	54.74	35.65	46.77

Source: Gunatilleke, N. (2000). Basic MIMAP Poverty Profile: Sri Lanka Institute of Policy Studies, Colombo, Sri Lanka.

The current overall declining trend in poverty is probably the result of structural changes and opening of the economy, which has sustained a reasonably high rate of economic growth over the last 15 years. However, there is still a large proportion of the population, who remain susceptible and vulnerable to economic changes and income fluctuations, because they are clustered at the borderline of the poverty line. Poverty levels are particularly high among landless laborers, and among casual laborers employed in agriculture, mining, construction and the informal sector. Greater vulnerability and insecurity of the poor and those clustered above the poverty line, may be due to poor targeting of poverty alleviation programs, large increases in temporary and casual employment, and insufficient attention paid to risk management in agriculture.

Some general characteristics of the poor can be derived from different studies on poverty undertaken in Sri Lanka. For example, poor households are larger in size and have a higher dependency ratio. They have limited access to outside resources and little or no productive assets. There is a higher incidence of female-headed households among the poor. Members of poor households have lower levels of educational attainment and a greater proportion of unskilled labor. The level of under-employment, seasonal employment and unemployment is higher among the poor. There appears to be no relationship between poverty and ethnicity or the type of occupation. The poor can be found among many occupations, including semi-subsistence farmers, low-income market-oriented farmers, self-employed individuals, urban workers and the self-employed in the tradable and non-tradable sectors (Tudawe 2000).

Sri Lanka has been committed to a well-established social welfare program, providing free health and educational services, since the early 1900s. Public expenditure on health and education grew to 6 percent of the GDP in 1948-52 and remained at that level up to the 1970s (World Bank 1990). As a result of improved health care and education, mortality rates declined rapidly and population increased at rates close to 3 percent, resulting in a large population increase in the 1950s. Improved education and other social welfare programs began to have an impact on population growth rates, which started to decline by the early 1980s and have been declining ever since. Apart from education and health services, the Government introduced a food subsidy program to reduce the impact of World War II. This program, which was initiated in the 1940s and continued up to 1977, provided a fixed amount of rice and wheat flour at a subsidized price to all households in Sri Lanka (World Bank 1990).

With the opening-up of the economy in 1977, an attempt was made by the government to target food subsidy programs to the really poor and needy population. In 1978, the food subsidy program was restructured and redirected to the poorest of the population. Consequently, food subsidies were issued only to households with a monthly income of Rs 300 or less, for five or more persons. The number of people receiving food subsidies was halved as a result. Towards the end of 1979, food subsidies in the form of a rationed quantity of food was eliminated and replaced by a Food Stamp Program (FSP), for those earning below Rs 300 per month. An evaluation of the FSP showed that only 38 percent of the total food stamp payments reached the intended poorest or 20 percent of the population (World Bank 1990). The remainder of the subsidy went to higher income groups. The FSP is undergoing restructuring to increase the proportion of the subsidy actually reaching the poor from 38 to 80 percent. This would eliminate about half of the number of current beneficiaries of the subsidy scheme.

The food subsidy program provided free or subsidized food to all households, but the first real attempt at poverty alleviation was the "Janasaviya Program" (JP) initiated by the Government in 1989. This program intended to transfer Rs 2500 per month to each poor household for a period of two years. In addition, JP included components for credit-based entrepreneurial development. An evaluation of the Janasaviya Program (World Bank 1990) identified its many shortcomings. In addition to the program being too costly to be sustainable, the selection criteria were not defined precisely and the benefits not related to incomes, leading to inequities and the inclusion of non-poor within the program. The benefits were high compared to the prevailing income levels, leading to a disincentive to work. Poverty, being a long-term problem, could not be resolved within the two-year limitation of the JP. There was also no provision for the inclusion of families falling into poverty after the selection process was completed. In addition to the JP, another program, the Mid-Day Meal Program (MDMP) targeted towards children was started in 1989. A total of US$50 million was spent annually in providing one meal a day to all children in primary and secondary schools under the Mid-Day Meal Program. This program failed, because it was too costly to sustain and did not reach the group which was nutritionally most at risk, i.e., the pre-school children.

The Janasaviya Program was scrapped after the formation of the new Government in 1994. After the scrapping of the JP, a more ambitious poverty alleviation program called the "Samurdhi" program, was put into operation by the new government in 1995. This program, which is basically an income transfer program, provides direct cash grants to more than 2 million poor families (55% of the population). In addition to cash grants, several other subsidiary activities were being implemented through this program to alleviate poverty. These included community and infrastructure development projects, savings programs, banking and credit programs, social insurance programs, training and entrepreneur programs, and self-employment schemes. About 80 percent of the funds

allocated to the program were utilized for income transfers intended to provide a consumption supplement. In this case, the amount of transfer was related to the income of the household and ranged from Rs 100 to Rs 1000 per month per family, depending on the household size. The other components of the program were intended to expand the productive asset base of the poor and to create employment and income through community infrastructure development (S. Kelegama 2001). As per the World Bank (2000) evaluations, both the design and implementation of the Janasaviya and Samurdhi programs were flawed, and their effectiveness in creating opportunities for empowering the poor to overcome economic and social barriers minimized as a result. Political bias of administrators and mobilizers of poverty programs, poor targeting of the programs to the poor and lack of participation by the poor in the development process have been identified as some of the flaws in these programs. These costly poverty programs (up to 1% of GDP) did not create sufficient opportunities for the poor. Large expenditure on poorly targeted transfers, lack of sustained rural work programs, long-term administrative costs of hiring poverty workers (over 30,000 workers in the Samurdhi Program), and weak exit mechanisms are some of the issues that have to be addressed.

Based on these experiences and current knowledge, Sri Lanka, through its National Planning Department and relevant line ministries, has now finalized a Poverty Reduction Strategy. This strategy is based on three key elements:

- Creating opportunities for the poor to participate in economic growth; it is expected to harness engines of pro-poor growth to enhance livelihoods, increase incomes, and ensure essential services to the poor.

- Strengthening the social protection system; the major thrust of the social protection system will be proper targeting of real beneficiaries and integration of the poor into the mainstream economic development, without inspiring dependency and eroding community initiatives. Where the Samurdhi program is concerned, it will be converted into a social insurance program in place of cash grants.

- Empowering the poor and strengthening the governance; the view that poor groups must operate in partnership with local government, decentralized public service agencies, and Community Based Organizations (CBOs) to demand quality service and to mount appropriate community development initiatives is accepted. For this, the poor need to be empowered and given a voice in the decision-making process.

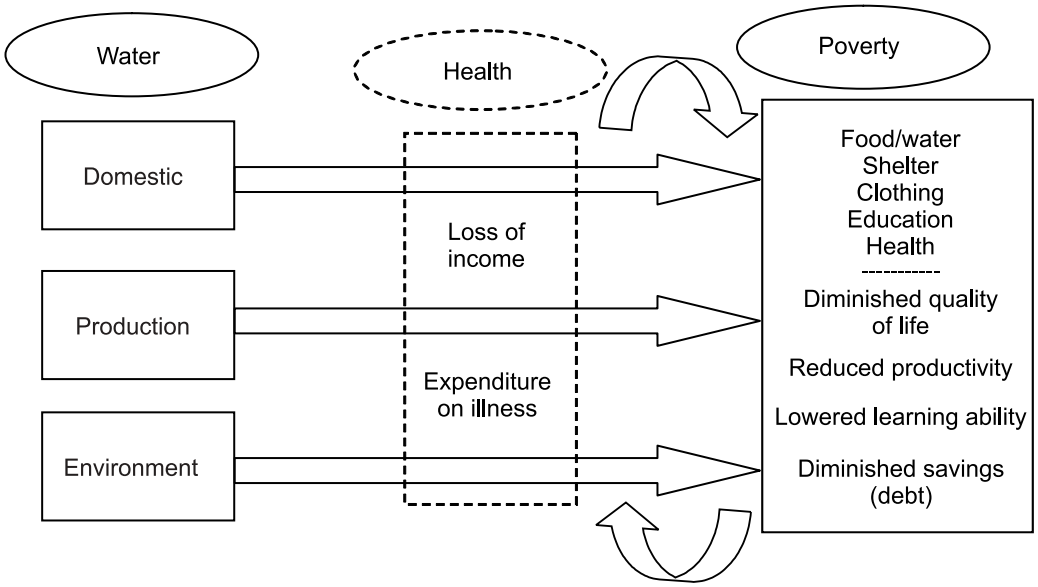
A strategy developed on this basis is now in force, though the practice of the theory and its success are yet to be proven.

WATER, HEALTH AND POVERTY LINKAGES

Around 10,000 people die every day from water and sanitation-related diseases and illnesses; a majority of them are the poor from the developing world. Health and poverty have a two-way relationship i.e., poverty is both a cause as well as a consequence of poor health. Poor people remain unable to secure even the basic necessities of life – adequate food, adequate safe water, clothing, shelter and health care. Poverty restricts or deprives access to healthy living conditions, access to nutrition, access to preventive measures, and effective treatment, and therefore the poor are more

likely to suffer from adverse health effects, and suffer from them more often. In addition, poor health and illnesses have a negative effect on livelihoods. Unhealthy people are much less productive. To escape from poor health and to treat sudden illnesses often requires money, which the poor do not have. The loss of income and the inability to pay for the cost of treatment can push a family into debt, plunging them into the cycle of poverty. A simplified view of the connection between health and poverty, and the linkages with water, is shown in figure 4.1.

Figure 4.1. Water, health and poverty linkages—a simplified framework.



It is evident from the linkages framework given above that any single positive outcome towards reducing poverty will have a cyclic effect, resulting in improved productive output and health and consequently, a further reduction in poverty; hence, an upward spiral improvement. Similarly, adverse effects will have a downward spiral effect.

In order to more clearly understand pathways and linkages between water, health and poverty, we can classify use of water into one of the following three broad categories: water for domestic consumption, water for production purposes and water for environmental sustainability.

Water for Domestic Consumption: Water is a basic human need and essential for survival. Access to a basic minimum quantity of safe water (roughly around 20 liters per person per day) is every one's right. Unlike all other goods, the utility and value of a glass of water for an extremely thirsty person is infinity. Similarly, the value of water for other domestic uses such as food preparation, hygiene and sanitation is also very high. These uses of water are directly related to health. A large number of diseases, including, diarrhea, dysentery, and cholera are caused by these direct uses of insufficient or unsafe water, leading to both short-term as well as long-term health impacts.

Lack of availability of adequate safe water for domestic uses forces the poor to extract water from alternate sources such as: (a) often fetching water, generally of poor quality, from long distances with much drain on time and energy, particularly of women and children, sometimes preventing them from spending time on income-generating activities and on schooling, respectively, or (b) incurring higher financial costs by buying water from informal vendors.

Water for Production - Irrigation/Agriculture: Water for production, especially in the agricultural sector, has been regarded as a powerful factor for providing food security, protection against adverse drought conditions, has increased opportunities for more employment and stable income, and for offering opportunities for multiple cropping and crop diversification. Access to reliable irrigation enables farmers to adopt new technologies and intensify cultivation, which lead to increased productivity, overall higher production, and greater returns from farming. This, in turn, opens up new employment opportunities, both on-farm and off-farm, improves income and livelihoods and the quality of life in rural areas, and reduces the vulnerability caused by seasonality of agricultural production and external shocks. All these factors contribute to alleviation of poverty. However, there are also negative impacts of irrigation (mostly associated with poor management) that tend to increase poverty. Water logging of land and increased salinity, land degradation, depletion of ground water and changes to biodiversity are some of these, resulting in the development of unfavorable conditions in relation to health, in terms of vector breeding, pathogen transmission etc.

Water for Environmental Sustainability: Water is essential for environmental health and ecological balance, just as safe water is essential for human survival and good health. In addition to its role in maintaining ecological balance, it plays a key role in human livelihood and poverty as made clear in the following statement:

"the poorest often suffer most from the consequences of environmental degradation because of their immediate dependence on the natural resource base for their basic necessities (food, energy, water and housing). Much of the income of the rural poor is derived from natural resources and environment-dependent agricultural activities. Surveys from 13 developing countries show that the rural poor depend for 40-85 percent of their income from agriculture," (Pinstrup-Andersen and Pandya-lorch 1994).

Many poor, rural communities depend on sensitive ecosystems such as forests and lakes, but are often forced to overexploit these natural resources in order to meet their basic needs and survive, thereby causing severe degradation of the systems. Groundwater resources are particularly vulnerable in this regard. In too many cases they are abused to such an extent that they can no longer provide for any productive agricultural needs or for the community's basic needs and end up posing serious health risks, thus adding to the poverty equation. Poor management of natural water bodies can also result in providing habitats for disease vectors.

An environmental aspect related to domestic and productive water consumption is the generation of wastewater. Wastewater can impose negative impacts including the incidence of wastewater borne diseases, as well as degradation of both land and water resources, including groundwater resources. While wastewater and its nutrient contents can be used for crop production, it can, however, also provide benefits to the communities.

The main source of hazards in wastewater from the domestic sector are pathogenic micro-organisms (bacteria, viruses, protozoa and helminthes), while the major source of water pollution from the industrial sector are heavy metals. Heavy metals can accumulate to the level of concentrations that can cause toxicity to humans. While the affected groups also include populations consuming vegetables irrigated with wastewater, the most affected groups are the poor smallholder farmers and laborers.

DOMESTIC WATER IN SRI LANKA

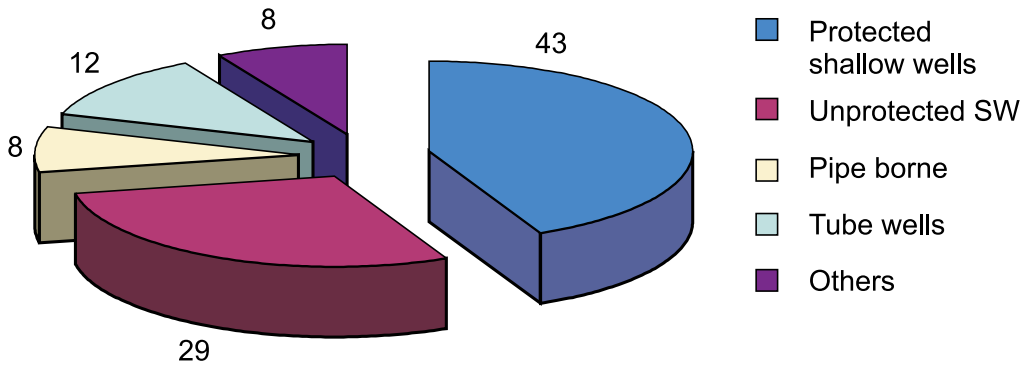
A full analysis of the domestic water scenario in Sri Lanka is not attempted here. Rather, some salient and interesting aspects are highlighted. As given in table 4.4 below, the piped water coverage for Sri Lanka as a whole is only 32 percent, but the coverage for the rural population is a mere 14 percent. However, access to safe drinking water is higher but still limited to only 57 percent of the rural population. The Government of Sri Lanka has a national goal for water supply with a target of safe water for all by 2010**.** The data also indicate that almost 70 percent of the present rural population (about 60% on a total population basis) obtains their domestic water from shallow ground water using wells; some of them are protected against surface water run-off while others are not. Figure 4.2 indicates this breakdown where it is seen that 43 percent are protected shallow wells, while 29 percent are unprotected (Jayasiriwardena 2002).

Table 4.4. Water supply situation in Sri Lanka, 1998 .

	Urban	Rural	Total
Population 1998 (M)	5.61	13.04	18.65
Piped water (%)	75	14	32
Tube wells (%)	10	11	11
Protected shallow wells (%)	10	40	24
Other (%)	5	35	33
Access to safe water (%)	90	57	67

Source: C.H. de Tissera, 1999. Urbanisation and Water.

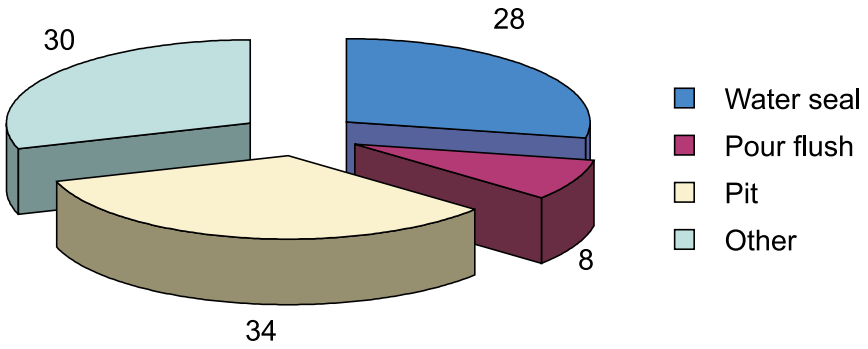
Figure 4.2. Rural water supply by facility.



Source: NWSDB, 1994.

As shown in figure 4.3, almost all the households use some type of pit latrine to dispose off their excreta, except septic tank users, who form a very small percentage of the rural residents. With rapid urbanization expected over the coming years, the load of sewage which uses the shallow overburden as the soakage area will also increase. With the cost of providing infrastructure, such as piped water and sewerage, being exorbitantly high, mass-scale contamination of shallow ground water, particularly in the peri-urban areas is quite high.

Figure 4.3. Rural housing units by type of toilet (%), 1994.

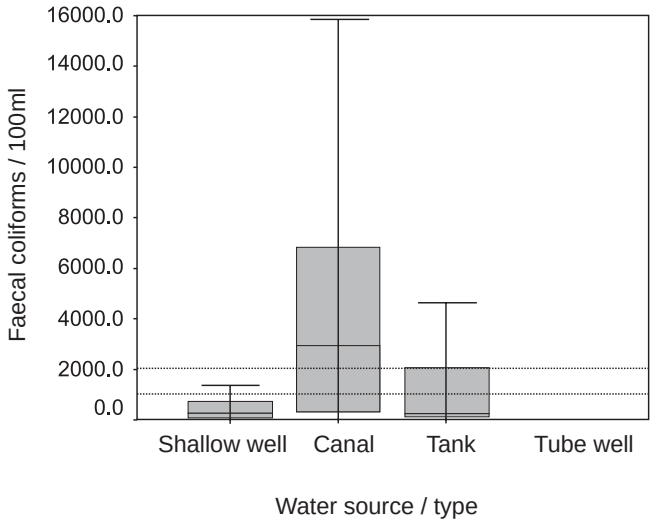


Source: NWSDB, 1994.

Groundwater aquifers depend mainly on surface water for recharge and as such, indiscriminate withdrawal of groundwater causes a serious threat to its sustainable use. Competing uses of ground water for agricultural purposes through agro-wells has also created pressure on the domestic water users. Ground water resources are not well regulated in Sri Lanka through policies or institutions, despite their importance in the domestic water sector. It is very important to adequately cover this issue in the emerging water policy initiatives in Sri Lanka, as well as in many other countries in the region.

Another interesting phenomenon is the multiple use of irrigation water in the rural agricultural areas. In the Walawe river basin in Sri Lanka, irrigation water is directly used for household use but is also found to be a direct means of recharging ground water (Boelee and Van der Hoek 2002). The conclusion is that irrigation water management without taking note of its other uses can be counterproductive in a holistic sense, depriving the community of one of its essentials— well water for domestic use (Meijer et al. forthcoming). In terms of biological water quality, surface water is unsafe and deep ground water is safe, and the quality in shallow wells is better than in reservoirs and canals (figure 4.4). Protected shallow wells show a considerable improvement in quality compared to unprotected shallow wells. Sources of bacteriological contamination of surface and ground water are generally from human settlements and livestock. Contamination from on-site sanitation as discussed earlier is considerable (Shortt et al. forthcoming). Use of such water leads to the transmission of water-borne diseases such as diarrhea, typhoid, cholera, viral hepatitis A, and dysentery.

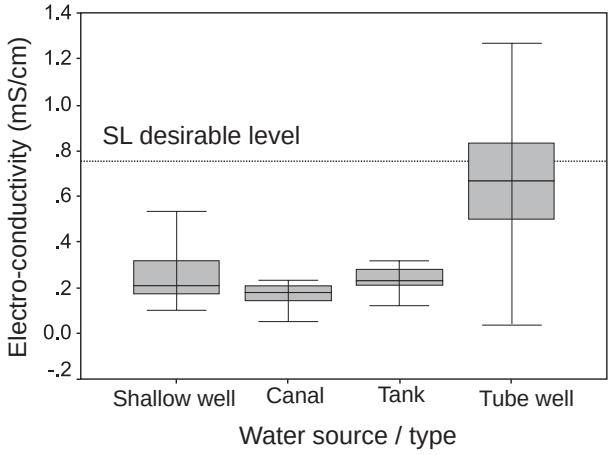
Figure 4.4. Walawe basin: Biological water quality.



Source: Shortt et al., (forthcoming).

Although deep groundwater is generally microbiologically safe water, it need not necessarily provide a water source that is free from chemical constituents that are harmful to health. Most of these arise from naturally occurring chemicals such as Arsenic, Chlorides, Fluorides, Iron and a host of other possible contaminants. Chemicals such as nitrites/nitrates and pesticides from agricultural activities mainly contaminate the surface water sources but also gets transported into groundwater, depending on a number of factors such as the soil condition and the depth of the water table, as illustrated in figure 4.5.

Figure 4.5. Walawe basin: Salts in water.



All in all, the effects arising from drinking water contamination, either bacteriological or chemical are considerable as shown in the box below.

SOME HEALTH FACTS

- Intestinal infectious diseases caused 831.7 cases of hospitalization per 100,000 population in the year 1999—a total of 158,379 cases.
- Intestinal infectious diseases caused 1.2 deaths per 100,000 population in the year 1999—a total of 226 deaths.

  (*Source:* Sri Lanka Annual Health Bulletin—1999).
- Over 50% of the population is affected with Fluorosis in the study area

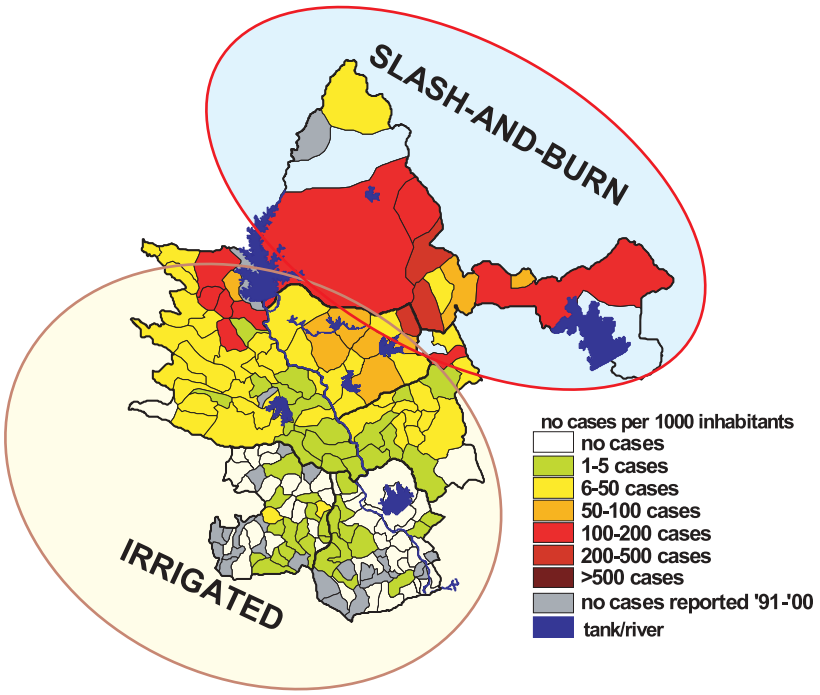
  (*Source: Van der Hoek et. al., forthcoming).*

IRRIGATION, POVERTY AND HEALTH

It is clear that in general, irrigation improves economic prosperity, leading to improved health and reduced poverty. Irrigation can, however, also have an anti-poor element, especially when irrigation systems are poorly managed. Some of the adverse impacts can include: water logging and salinity; land degradation due to intensive agriculture; depletion of ground water; and change in biodiversity.

In terms of health aspects, these factors may lead to increased disease conditions, for example, increases in vector-borne disease habitats and increased transmission of pathogens. A recent IWMI study (Klinkenberg et al., forthcoming) carried out a risk-mapping exercise for malaria in the Uda-Walawe irrigation system in Sri Lanka producing some very interesting results shown in figure 4.6. This study showed that an increased malaria risk was found in areas with more than average rainfall or large areas under forest cover or in *chena* cultivation (i.e., slash and burn cultivation). Irrigated areas had a low risk for malaria. Furthermore, the presence of abandoned tanks and poorer socio-economic status was associated with a higher risk. People in the irrigated areas had a higher socio-economic status than those in the chena areas and were therefore likely to live in better constructed houses, make more use of bednets and medication, and have a generally higher nutritional (health) status. The study showed that the malaria risk is higher outside the irrigated areas and is associated with lower socio-economic status, chena cultivation and presence of abandoned tanks. This is a good case illustrating the interactions and links between health and poverty with water being the common denominator.

Figure 4.6. Malaria incidence map: 1991-2000 (Uda-Walawe, Sri Lanka).



(Based on Klinkenberg et al, forthcoming, 2002)

A similar IWMI study (Konradsen et al. 1997b) covering a different region of Sri Lanka attempted to determine the economic costs of malaria, and investigated how these relate to household incomes and poverty. Table 4.5 below summarizes some of the findings related to costs.

Table 4.5. Household expenditure per episode of malaria—evidence from Sri Lanka.

Item	Expenditure per episode (Rs)
Transport	31.8 (0-300)
Blood examination	1.8 (0-95)
Treatment	19.5 (0-530)
Meals at health facility	29.6 (0-600)
Special diet at home	47.6 (0-350)
Other (such as hiring labor)	18.7 (0-625)
Sub-total	149.0 (0-1029)
Loss of working days and school days	The number of average days lost per episode of malaria was 7.8 days of the patient and 2.9 days of the person accompanying the patient to the health facility. At an average wage rate of Rs 75, the economic cost of productive time lost amounts to Rs 802.

Source: Based on Konradsen et al. (1997a).

With a median annual net income of Rs 12,900, some families spent up to 10 percent of their annual income per episode of malaria and some experienced several episodes of malaria per family per year. The working days lost by the economically active age group (14-60 yrs.) was 1.8 percent due to malaria and 5.6 percent due to all other illnesses. The economic costs, including the opportunity cost of productive time lost, are estimated to be Rs 802 for malaria and Rs 2,400 for all other illnesses—a substantial component of annual income, no doubt having a significant effect on their poverty status. The importance of controlling these disease conditions is further borne out by the fact that a survey amongst these villagers which asked them to identify and rank their three biggest problems had malaria ranked third, following inadequate water for cultivation and poverty. Also, malaria was considered to be their major health problem, followed by diarrhea and eye diseases. Among 216 households included in the study, there were 178 self-reported episodes of malaria. The number of episodes ranged from 0 to 5 per individual and from 0 to 11 per household (Konradsen et al. 1997a).

KEY LESSONS

- Sri Lanka has experimented with a range of social welfare programs targeted at the poor, some more effective than others but all with many deficiencies in absolute terms. A close analysis of these experiences will enable identification of the weaknesses and help develop more effectively targeted schemes for Sri Lanka as well as other countries of the region.

- Emerging water policy initiatives must take note of the need to well regulate groundwater, as it is important for different countries from different perspectives.

- Irrigation water is often a direct source of drinking water as well a means of recharging ground water. An integrated view needs to be taken in planning these systems as well as managing them.

- Proper management of irrigation systems is very important, not only from a point of view of minimizing degradation of natural resources which affect people's livelihoods, but also from the perspective of minimizing and controlling associated disease causing mechanisms.

It is noteworthy to highlight the role of partnerships in carrying these lessons from research to the stakeholders, and towards practical implementation. This is the approach adopted internationally by the GWP-SASTAC (Technical Advisory Committee)partership, and in Sri Lanka, by the Sri Lanka National Water Partnership (SLNWP), named "Lanka Jalani". These partnerships believe strongly that optimal realization of research is possible only through cooperative activity by Governments, Civil Society Organizations, and the private sector. The partnership organizes, facilitates and assists in bringing these sectors together and developing activities aimed towards implementation. Development of the regional activities on poverty, described above, with regard to the Water and Poverty Initiative of the ADB and WWF3(World Water Forum) is a good example of how these partnerships achieve this.

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Chapter 5

Agricultural Water and Poverty: A Case Study from the Dry Zone of Sri Lanka

Dhanawardana Gamage

INTRODUCTION

Water is the most important natural resource base for the livelihood of the poor in developing countries. In addition to using water for drinking, cooking, sanitation and other household activities, the poor use water as an enabling resource for making a livelihood. Agricultural production, either for subsistence or sale, is the main livelihood in rural areas in almost all developing countries. The poor base their livelihood on water in growing food crops and watering livestock and as a basic resource for small-scale production, such as making bricks or brewing. The poor also depend on other water-based resources like freshwater fish and harvesting of aquatic plants and roots in meeting their general food needs, or as coping strategies at times of distress. In irrigated areas, water is used not only for crop production, but also for domestic use, home gardening, growing tree crops and other permanent vegetation and livestock.

These general descriptions of the uses of agricultural water by the poor are fully applicable to the Hambantota District in Sri Lanka. Located in the Southern Province, Hambantota, is one of the twenty-five districts in the country. This district commands a total land area of 2,609 square kilometers and is the twelfth largest in the country.[33] Around 95.8 percent of the district population is rural, and an estimated 57.4 percent of the labor force is engaged in agriculture. Industrialization is low with around 9.2 percent of the labor force employed in manufacturing. This district is largely classified as arid.

Many are of the view that development in the Hambantota district has been limited by agro-climatic conditions, especially by aridity and a dearth of exploitable natural resources. However, from ancient times, agriculture has been the basis of the district's economy. The dominant type of production has been irrigated paddy farming. In addition, settlers in un-irrigated areas grow other field crops on highlands using rainwater. However, under present conditions (e.g., vagaries of rainfall, smallholder operations, lack of extension and dwindling land availability), farmers have been able to produce little surplus beyond basic sustenance. As such, they often work as hired laborers or engage themselves in small-scale production or business activities and other similar types of employment, to complement the living they earn from farming.

[33]The estimates of the area under the district differ between sources and the above figures are from the Department of Census and Statistics. According to the estimates prepared by the Land Use Planning Division of the Ministry of Agriculture, based on aerial photographs, there are 2,62,649.8 hectares belonging to the district.

Major efforts have been made in recent years to increase the irrigated area of the Hambantota District. This study attempts to examine the major trends in the development of the region, and reviews recent studies which have examined how irrigation provision has impacted poverty in the area. The study begins with an overview of climatic and resource conditions in the district. This is followed by a discussion of recent changes in the agrarian economy, and the current socio-economic situation in Hambantota. The study then turns to an examination of Hambantota district's irrigation systems and their relationship to poverty, using a series of previously completed case studies. In the final section of the paper, conclusions and lessons are drawn from these various studies, in order to shed light on the general linkages between irrigation and poverty reduction.

HAMBANTOTA DISTRICT: THE SETTING

Compared with 1,850 mm of average annual rainfall for Sri Lanka as a whole, annual average rainfall in the Hambantota district is 1,016 mm. Rainfall occurs between October to January and April to May, while February to March and June to September are usually dry. Within the context of Sri Lanka, rainfall of these levels justifies the district's classification as part of the country's "dry zone". Prolonged drought spells were observed during the last four years, and the situation was most acute in 2001. In terms of temperature, the district averages 26.9^{o}C, and temperature levels reach a maximum of 30.9^{o}C in the months of June, July and August. Temperature levels go down to about 22.7^{o}C in December to January. Based on rainfall, temperature and other characteristics, the district has been classified into 5 zones. These are Intermediate Mid-Country (IM 2), Intermediate Low Country (IL 2b), Wet Low Country (WL 2b), Dry Low Country (DL 1) and Dry Low (DL 5). IM 2, IL 2b and WL b receive about 1,905 mm of annual rainfall, DL 1 receives about 1,270 mm of rainfall while DL 5 is the driest and largest ecological zone in the district. The wet and intermediate zones cover about 22 percent of the land area and the rest of the area has dry or arid conditions. Agro-climatic factors are estimated to limit the agricultural production to about 43 percent of the land area in the district (Dayaratne and Kulatunga 1991: 169).

The district population has grown from 340,300 persons in 1971 to 525,370 persons in 2001. Rapid growth has brought much pressure on the land. The population density per square kilometer in 1971 was 131 persons, and it had reached 204 by 2001.[34] Almost 96 percent of the people live in rural areas, and the predominant population in the district is Sinhalese (97%).

The burgeoning population has brought pressure on the limited cultivable land. Due to its more favorable environment, the wetter western part of the district has attracted a higher population density, than elsewhere. However, this has also resulted in high landlessness, and the dryer eastern areas of the district are now attractive to the landless. As a result, the landless from western regions are migrating to the dryer eastern areas to find land for farming and housing. The eastern part of the district has also attracted the landless population from nearby wet zone districts, where the population density as in western Hambantota, is much higher. Thus, lands in the eastern parts of the district are shifting rapidly from being a frontier area to one of intensive cultivation.

[34]Population census in 1991 was not carried out due to unsettled conditions in the east.

Sixty percent of the rural people in the district seek out a livelihood in agriculture or in related work. Especially in semi-arid areas in the district, the economy is dominated by agricultural and fisheries production. Paddy farming under irrigated conditions is the mainstay of the district's economy. The most important source of income for the coastal population is fishing and related work. In addition, the inhabitants of the upland areas practice farming in sedentary and shifting systems, though this latter practice is declining. The district's formal wage sector, both in public sector agencies and private sector enterprises is limited. Waged sector employees such as public sector workers constitute a small proportion of the workforce. This sector is mainly confined to those employed in education, health, administration, service institutions and local authorities. The district has not attracted much private sector investments in the past and as such waged employment in the private sector has been significantly limited. The small enterprise sector has been given a helping hand by a number of people's organizations assisted by public sector organizations. Employment created in the small enterprise sector, mostly, is of the self-employment type.

Land Resources and Major Land Uses

Of the total area of 260,930 hectares of land that comes under the district, about 52.5 percent is non-agricultural. Of this, 131,350 hectares (49.6%) consist of national parks, forests and forest reserves. Estimates of the forested area vary from 33 percent to 35 percent. Lagoons, roads, and towns also cover 12,045 hectares (2.5%) while 2,980 hectares (1.14%) are under water bodies. Of the remainder of the land, about 30 percent is classified as agricultural. Of the arable land, about 68,230 hectares or 26 percent is under paddy, coconuts, export crops, other perennial crops and homesteads, while 6 percent is cultivated with temporary crops or as chenas. The predominant soil types in the district are reddish brown earth and alluvial soils of variable drainage.

Water Resources and Irrigation

Ten rivers/streams drain the Hambantota district, benefiting an area of about 5,028 square kilometers.[35] However, the run-off percentage, evapo-transpiration, and the seasonality of rainfall and river regimes pose a severe limitation on water availability in the district. Excepting the four perennial rivers, others which drain the district undergo periods of water stress, almost annually. The Kirindi-Oya basin is the most water-stressed among them as it has the lowest per capita surface run-off and a relatively high demand for its waters. With rainfall being concentrated during the two seasons, varying greatly from year to year and with uneven distribution over the space, irrigation water has been a major resource for farming, home consumption, recreation, sanitation and hygiene in the district from ancient times. For example, there are 193 known tanks built in the district before the advent of modern era irrigation tank construction. Since the independence of the country in 1948, many large reservoirs (e.g., Kirindi-Oya, Lunugamwehera, Kirama Oya, Muruthawela) have been added to the existing stock and filled through diversion of river water that flows through the district. These new schemes have added about 9,200 hectares to the existing irrigated area.

[35]Major rivers like Walawe Ganga, Kirindi Oya, Menik-Oya and Kumbukkan-Oya have catchment areas amounting to 1,000 to 2,500 sq. km. Other streams that are of medium size have relatively smaller catchment areas: Kirama-Oya (225 sq. km), Urubokka-Oya (352 sq. km), Malala-Oya (400 sq. km).

By the turn of the century, there were 20 major irrigation schemes in the district with an cultivable area estimated at 21,207.[36] There are also 723 minor tanks with a total irrigable area of 4,066 hectares. Much of the land asweddumized for paddy has been provided with irrigation water under major irrigation schemes.[37] H2owever, not all irrigation schemes function as originally planned. About half of the area asweddumized for paddy under the Kirindi-Oya and Murutha Wela tanks are left uncultivated due to water shortages. As a result, many farmers who depend on waters from these schemes face serious water shortages. To further complicate matters, areas classified as DL 1 and DL 5 zones tend to have especially high salinity hazards which greatly impact the lower parts of the irrigated areas.

In fact, much of the groundwater in the district is salty or brackish, which, because of high evapo-tranporation rates, causes a high concentration of salt in the soils. Groundwater also tends to be high in fluoride and iron, and only about one-fifth of the ground water in the district is suitable for human consumption, though the areas with somewhat salty water can be used for livestock farming.

Other Field Crops grown under Rain-fed Conditions

Other Field Crops (OFC) cultivation on highlands depend mainly on rainfall and, therefore, undergoes significant fluctuations in the cultivated area as well as in the crops grown. Besides suffering from the vagaries of weather, crops cultivated under rain-fed conditions also suffer from market price fluctuations and other macro-economic policy changes.[38] Except for a few crops like cowpea, groundnuts, manioc and green gram, the area cultivated with OFCs has dwindled over time mainly due to changes in the rainfall pattern.

Animal Husbandry

There is a relatively firmly established animal husbandry sector in the Hambantota district.[39] Buffalo curd has been a traditional cottage industry that the district has had a reputation for, for a long time. In spite of many obstacles such as the relative and absolute decline of the area under grass and fodder,[40] the curd industry has thrived over the years by extending curd supplies to major cities like Galle and Colombo. Rearing cattle is another form of traditional animal husbandry practice that prevails in the district. Goat has been introduced to the district newly, and there is a goat population of about 25,000.

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[36]Some estimates put the area irrigated at 26,838 hectares. This is possible as some farmers cultivate larger areas than authorized.

[37]According to Pieris (1996:199), 87 percent of the total extent under paddy in the Hambantota district in 1990s was under major irrigation, 9 percent under minor irrigation and 4 percent rain-fed.

[38]As Hewavitharana**,** (2002:5), puts it: "Small holder's and poor man's crops known as Other Food Crops (OFCs) and Subsidiary Food Crops (SFCs) suffered severely under the policies of trade liberalization and de-subsidization, and also under the impact of the floating Rupee which escalated the cost of inputs". Hewavitharana also links the problem to the high reserve supply price of labor in the country competing out the Sri Lankan small producer with cheap imports from India.

[39]In 1982, the district had 27,055 buffaloes, 52,964 neat cattle, 58,205 chicken, and 3,039 goats. The number of all animals, except cattle have grown over the years. For instance, by 2001 the district had 55,900 buffaloes, 75,300 neat cattle, 104,000 chicken, and 15,400 goats.

[40]This occurs due to denudation associated with overgrazing, salinization, and deforestation, prolonged drought spells, clearance of land for human habitation (especially under the assisted settlement schemes like Lungumawehera) and spontaneous settlement of land previously used for grazing by the landless.

Fisheries

Hambantota district has a coastline of 145 km and 21 perennial water bodies covering a total area of 7,836 hectares, indicating the potential for marine fisheries development.[41] A significant improvement in the coastal zone that consists of a 2-km wide area along the coastal belt from Kudawella to Kirinde has been made in the last two decades. Commensurate with this development, there has been an incremental growth in the fisheries sector in terms of fishing gears used, fish catch and a population dependent on fisheries. However, it appears that the fisheries sector in the district economy has not realized its full potential so far, and the fisheries resources, including inland fisheries resources, remain largely untapped. There are about 5,000 families that depend on fisheries.

Industry

Industrial development in the district is in its embryonic stage. The slow growth of the industry is due to a number of reasons. First, in general, it has the disadvantage of being a dry-zone district. Industrial development in almost all dry-zone districts, has tended to lag behind, in comparison to many wet-zone districts where industries have shown a propensity to locate,[42] though in fact, only a few districts like Colombo, Gampaha and Kalutara have experienced industrial development over the past two decades. Second, Hambantota district is located far away from the centers of economic activities (i.e., the capital city, seaport and airport). In addition, long travelling time makes it more remote than the actual distance indicates. Therefore, except for salt production for which the district has a comparative advantage, paddy milling and a few garment industries, the industrial development in the district has been very limited. For instance, in 1998 there were 23 industrial establishments; only 10 of these employed over 100 employees, other11 establishments employed between 25 and 50 employees.

A major tourist attraction in the district has been the Yala National Park which had been closed to both local and foreign tourists for a long duration due to the civil war. There are only a few hotels catering to the tourist industry, and the hotel management suggests that arrival of tourists in the district have declined in the recent past. One major factor that they attribute this problem to is the armed conflict in the North and East that puts away foreign tourists.

Roads and Communication

Three major routes (“A” grade roads) connect the district with other areas like the capital city, Colombo. An extensive network of “B” grade roads connects interior places with towns located along the coastal belt. Though the road networks in the district are poor in comparison to the provincial situation or many other districts in the country, the interior road system has improved substantially in the recent past. In many areas, the road system has been improved along with investments in major irrigation schemes like KOISP (Kirindi Oya Irrigation Project), and Udawalawe Left Bank Irrigation Project.

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[41]14 of these perennial water bodies are located in the relatively dryer eastern parts of the district. Lagoons in the area cover 2,833 hectares.

[42]For instance, the districts that constitute the dry zone accounts for 13.2 percent of the country’s population, but have only 6.1 percent of the total industrial workforce (Pieris 1996:275).

AGRICULTURAL AND AGRARIAN DEVELOPMENT IN THE DISTRICT

There have been considerable agricultural changes in the Hambantota District in the last two decades. Some of the major changes include:

1. Over the last two decades, irrigated land area has been expanded by about 10,000 hectares. However, both the asweddumized area and cultivated area under paddy have fluctuated significantly.[43] For instance, in 1980, 29,341 hectares were cultivated and this extent had been increased to 41,198, in 1995. However, the five-year average of the area under paddy between 1991 and 1995 had declined to 36,391. This factor can be mainly attributed to drought, continued salinization of irrigated lands and the conversion of paddy lands for housing and other construction purposes.

2. Commensurate with increased availability of irrigation water, average yield of paddy has increased over time. For instance, land productivity increased from 4,048 kg per hectares in the 1993/94 maha season to 4,354 kg/ha in 1999/2000. This gain is big, compared to the other irrigated areas in the country.

3. In recent years, there has been a trend towards crop diversification on irrigated lands. One illustrative example is the spread of banana (plantain) cultivation, which reached over 2,500 hectares in the 1990s. Moreover, bunches of plantains produced per hectare has increased from 590 in 1994 to 808 in 2000. Some lands formerly cultivated with other field crops and home garden crops have also been brought under more profitable banana cultivation, resulting in relatively speedier economic growth in areas such as the Suriyawewa Divisional Secretariat Area.

4. With crop diversification, ash plantain production has increased from 9,727 metric tons in 1994 to 15,260 metric tons in 2000, and green chilly production has increased from 1,972 metric tons in 1980 to 4,447 metric tons in 1999. Much of these achievements can be attributed partly to irrigation development.

5. Where groundwater is available and suitable for agricultural production, dug wells and tube-wells are also used for growing high-value other field crops (HVOFCs).

There has also been a discernible development in the agricultural production infrastructure (e.g., extension of the irrigated area under major tanks, rehabilitation or construction of minor irrigation schemes, development of rural roads and transport and storage facilities) in the district during the past few decades. However, this does not appear to have significantly triggered agricultural sector development. The factors associated with this situation appear to be many, as outlined below:

1. Agricultural production in the district is greatly influenced by agro-ecological factors such as aridity, vagaries of rainfall and salinity in the soils and water. About 43 percent of the total land area in the district are not suitable for agriculture, thus limiting the area available for cultivation for an expanding population.

[43]Land leveled and bunded for regulation of water supply for paddy cultivation.

2. The rainfall in the district is not only limited, but also highly localized and unreliable for farming or for other types of human use. Relatively dry areas cover over two- thirds of the district and have been especially affected by vagaries of weather and prolonged droughts during the past few years. As such, over 30 percent of the asweddumized area of paddy both under major and minor irrigation schemes in the district remain uncultivated mainly due to shortage of irrigation water or due to droughts.[44] As water availability is uncertain in the *yala* (minor) season, paddy is produced mainly during the *maha* (major) season under minor irrigation schemes and in rain-fed areas.

3. Much of the ground water in the district is mostly salty or brackish and has a high content of fluoride and iron. In addition, high rates of evapo-transpiration cause the concentration of salt in the soils.

4. In spite of its arid and harsh climatic conditions and a poor resource base, the district has a large population to support. The district supports a disproportionate portion of the total population inhabiting the entire dry zone.[45] For instance, the district commands only a 6 percent of the total area under dry zone. Yet, it accounted for 10 percent of the total population of the dry zone, 11 percent of the agricultural land, 14 percent of the small holdings, 12 percent of the area under home gardens, 8 percent of the area under paddy, 19 percent of the area under coconuts, and 12 percent of the area under chillies, in 1981.

5. Majority of the land holdings in the area are under 0.5 hectares. As industrial and service sectors have not developed to a satisfactory level to absorb surplus labor from agriculture, the population pressure on land continues, resulting in land, forest and water resources degradation. Many farming households have adopted complex tenure systems to access lands. Some families have subdivided existing, yet small, agricultural holdings to increase other family members' access to land. In this manner, tenurial problems have become an impasse not only for technological innovation, but also for proper land management, to increase land productivity. In such cases, irrigation can do very little to reduce poverty.

SOCIO-ECONOMIC DEVELOPMENT AND POVERTY

Hambantota district records an average monthly household income and expenditure level below the national average, but its income level is substantially higher than that in neighboring districts like Moneragala or Badulla. Similarly, its food ratio is close to the national average. Yet, the percentage of recipients of government food programs in the Hambantota district has been substantially higher in comparison to the national average. For instance, in the early 1980s about 60 percent of the people were receiving food stamps, though this is not a good indicator of poverty, as non-targeted groups also get access to them. In the year 2000, the percentage of households receiving food and economic support was 60 percent, compared to the national average of 39 percent.

[44]According to Pieris (1996), a gross extent equivalent to about 30-35 percent of the total area under paddy in the country remains idle over a great part of the year.

[45]The districts defined as dry zone include Hambantota, Mullaitivu, Vavuniya, Mannar, Jaffna and Puttalam.

Using data from Household Income and Expenditure Surveys (HIES) of 1990/91, and 1995/96, the percentage of households in poverty in Sri Lanka has been estimated at 30.4 percent in 1990/91, and 26.74 percent in 1995/96. The estimates for the rural sector were higher at 34.7 percent and 28.7 percent respectively, for the two periods. The corresponding figures were 36.8 and 30.3 percent respectively, for Hambantota. This shows that the poverty levels in the district are higher for both periods relative to the country as a whole, or for the rural sector, exclusively.[46] In addition to its poor resource base, slow progress in the district could also be attributed to its historic character, as poverty has predominated the district throughout its known history.

The regional pattern of development in Sri Lanka varies substantially in terms of the four indexes (life expectancy, education, GDP and Human Development Index) used in ranking provinces and districts based on the Human Development Report of Sri Lanka by the UNDP in 1998.[47] In terms of the ranks arrived at for 17 districts for which the data were available, Hambantota district ranked the ninth while other such dry-zone districts like Kurunegala, Polonnaruwa and Anuradhapura ranked 2, 3 and 4 respectively.[48] On the other hand, the Southern Province itself ranked 5 out of the 7 provinces, for which the human development indexes have been arrived at. Only the Central and Uva Provinces ranking 6 and 7 respectively, were less developed in terms of the HDI than the Southern Province. Though Hambantota ranked below the average HDI for the country as whole, its HDI gap from the average index (.11) is smaller compared to the gap (.25) the Southern Province has. Its performance also is much better than the neighboring districts such as Matara, which ranked 15, and Moneragala, which ranked 16 in terms of the HDI.

EVIDENCE OF THE CONNECTION BETWEEN WATER AND POVERTY IN HAMBANTOTA DISTRICT

A recent study by IWMI in Sri Lanka's Uda Walawe Left Bank Irrigation System in the Hambantota District (Hussain et. al. 2002), suggests, that the incidence, depth and severity of poverty, as measured by both monetary and non-monetary indicators, was lowest in areas where households have access to irrigation infrastructure.[49] Contrastingly, the incidence of poverty and chronic poverty was highest in non-irrigated areas where rain-fed agriculture was predominant. Table 5.1, which is based on the above mentioned study, shows that in the rain-fed agricultural areas, one-fourth of

[46]Using a lower poverty line of Rs 791 per person per month, 22.9 percent of the population was found to be poor in the country in 1995/96 (HIES). By using a higher poverty line of Rs 950 per person per month, 25.9 percent of the population was found to be poor. Compared to the national situation, households under the lower poverty line in the Hambantota district were 27 percent and under the higher poverty line were 43 percent.

[47]HDI or Human Development Index is a composite index based on average achievement in three basic dimensions of human development: a long and healthy life, knowledge and basic standard of living. Sri Lanka had a HDI of 0.616 in 1975, 0.676 in 1985, 0.719 in 1995 and 0.741 in 2000 showing the improvement in human development over the years.

[48]The indexes have been calculated for 17 out of 25 districts, as data are not available for districts in the north and east due to the warring situation. The areas that come under Anuradhapura and Polonnaruwa districts have benefited from investments, especially in irrigation, under the country's largest irrigation cum land settlement project, namely the Mahaweli Accelerated Development Program.

[49]The study was conducted during the year 2000-2001 to determine the impact of irrigation infrastructure development on dynamics of poverty with a sample of 858 households. The study was conducted three times and applied a detailed multi-topic questionnaire to collect information from the sample households.

Table 5.1. Poverty head count (based on income) in the Udawalwe Left Bank area, 2001.

	Sevanagala, Irrigated	Sevanagala rain-fed	Kiriibanara	Sooriya wewa	Extension/ rain-fed	Ridiya-gama	Irrigated all	Rain-fed all	Farm	Non-farm	All
Incidence of poverty	167	60	151	229	105	146	693	165	724	134	858
Total poverty	0.71	0.88	0.85	0.87	0.84	0.75	0.80	0.85	0.82	0.77	0.81
- Chronic poverty	0.09	0.10	0.13	0.11	0.25	0.06	0.10	0.19	0.11	0.16	0.12
- Transient poverty	0.62	0.78	0.72	0.76	0.59	0.69	0.70	0.66	0.71	0.61	0.69
- Non-poor	0.29	0.12	0.15	0.13	0.16	0.25	0.20	0.15	0.18	0.23	0.19
Household annual expenditure	64,360	59,024	67,243	64,907	49,398	94,283	71,473	52,898	69,856	57,341	67,901
Household annual income (Rs)	112,062	111,281	71,202	81,523	66,080	132,945	97,467	82,517	99,814	66,377	94,592
Value of household assets (Rs)	18,232	13,694	17,240	19,517	8,532	32,394	21,418	10,436	20,165	14,795	19,339
Value of agricultural assets (Rs)	17,415	1,752	21,731	18,837	10,484	27,749	21,002	7,309	19,811	10,575	18,369
Housing index	74.4	73.6	78.9	73.3	69.2	84.6	77.2	70.8	77.5	67.8	76.0

households are living below the poverty-line, throughout the year. Data in the table also shows that chronic poverty is highest amongst non-farm households and in areas with no access to irrigation infrastructure. Contrastingly, the data points to the fact that household average incomes are higher in areas with access to irrigation infrastructure. Furthermore, in irrigated areas, households on average spend 24 percent more per month on consumption, than households in areas with no access to infrastructure. The study has also found that access to irrigation is associated with relatively high levels of food security, balanced diet and reduced vulnerability, both at the household and community levels. Household income, expenditure, value of household assets and the index of housing quality are also much higher in irrigated areas than in rain-fed areas. In sum, these findings indicate that there can be strong linkages between irrigation and poverty.

One key question is why irrigation seems to be associated with reduced poverty levels. The answer appears to lie, at least initially, in increased land productivity. As shown in table 5.2 and as would be expected, irrigated areas in Sri Lanka are associated with substantially higher crop yields. With respect to Hambantota district in particular, a study also found that irrigation not only increased yields, but also cropping intensity and profitability (table 5.3).

Table 5.2. Difference in rain-fed and irrigated areas in terms of cropping intensity, productivity and income.

	Rain-fed	Irrigated	% Increase
Cropping intensity (%)	95	157	39
GVP per ha (Rs)	10,034	19,403	48
Cash cost (Rs)	10,864	12,895	15
Gross margin	-829	6,519	112
Rice yield (t/ha)	3.2	4.5	40

Note: GVP = Gross Value Product
US$1 = Sri Lanka Rs 83 in 2000.
Source: Based on IWMI survey in Ruhuna Basin, 2000.

Table 5.3. The average yield (kilogram/ha) under different irrigation systems in 1997.

National average	3,618
Major irrigation	4,289
Minor irrigation	3,369
Rain-fed	2,843

Source: Central Bank of Sri Lanka, Annual Report 1997.

While such results are likely to be directly connected to increased average incomes, they do not necessarily explain why poverty would decline, since, it is the already relatively well-off with landholdings who are most likely to benefit from increases in land productivity. However, another study (Hussain and Thrikawala 2001) showed that irrigation was also associated with increased labor use (table 5.4) and wages, suggesting that there are strong spill-over effects even to the landless or those who don't have sufficient land resources for full-time occupation.

Table 5.4. Labor use per acre and wage rate under irrigated conditions for different crops in the Udawalawe Basin, Sri Lanka.

Crop	Rain-fed conditions	Irrigated conditions
Paddy	37.2	125.8
High-value crops (OFCs)	104.9	154.9
Wage rate (Rs/person/day)	202	173

Source: Hussain et al., 2002.

As intimated in the last example, it is clear that irrigation can have not only positive effects in poverty reduction, as was earlier described, but also negative effects. For example, it has been found that after the Kirindi Oya Irrigation System in Hambantota district came into operation, salinity levels in the older downstream irrigation systems have increased. Retardation in the growth of rice plants was observed in the affected locations, especially in poorly drained areas. In these instances, it is usually the poor who are affected the most. Drainage flows from the Kirindi Oya Irrigation Project and the Badagiriya Irrigation Project have also been shown to severely affect the Malala and Embilikala lagoons. Salinity of the lagoons has dropped, destroying prawn fisheries, which previously provided livelihood to several hundred poor families, and reduced populations of water birds (Matsuno, Van der Hoek, and Ranawake 1998).

In the other arid areas of the district, water logging and excessive leeching result in salinization of soils and/or increasing ground water levels, presenting a formidable problem for farming for three reasons. First, salinity makes it difficult for plants to absorb water through their roots system. Second, plants also absorb toxic irons from salt concentrated water. Third, salinity often affects the natural soils' microbial processes retarding the natural formation of nutrients. Besides the water shortage that accompanied drought in the last four years, water and land degradation in part brought on by irrigation, may account significantly for declining land area under paddy in the district.

CONCLUSION

The Sri Lankan experience confirms widely held convictions as to the linkages irrigation has with poverty reduction in tropical developing countries. First, irrigation has had a net positive impact on food production and maintaining stability of food supplies. This is achieved by increasing agricultural land in areas where hitherto agricultural production possibilities have been low, and playing a major role in the spread of new, high-yielding technologies, land use intensification and crop diversification. As examined in this case study, these have also resulted in increasing rural employment and rural wages through creation of additional on-farm and off-farm employment. Those especially benefiting from employment creation under irrigation schemes are the rural poor like the landless and unskilled laborers living in rain-fed areas, who migrate to areas with irrigation water in search of work.

In producing this study, the literature reviewed also revealed many areas of inadequacies in our knowledge of water and poverty linkages. One area needing attention is how wider structural inequalities emanating from ethnicity, gender, caste and class differences are responsible for the lack of access to water, and the implications of that—lack of access to poverty and poverty reduction. Existing knowledge on irrigation's impact on food security, health and nutrition is also insufficient. Nonetheless, it is already clear from the case study presented here that there are clear linkages between irrigation and poverty in Sri Lanka, and it appears that a careful study of the nature of

those linkages can help policy makers effectively target agricultural water programs to help the poorest members of society.

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Chapter 6

Water and Poverty Linkages: Summary and Lessons

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The four papers in this volume examined varying aspects of water and poverty linkages in different geographic and contextual settings, and using different analytical techniques. The first two papers were based on field surveys supplemented by literature reviews. The first focused on the impact of water on poverty in a mountainous region of Nepal, and the second on the impact of drought on water availability, and hence poverty, in a district in Pakistan's Baluchistan province. The final two papers both took Sri Lanka as their area of study. The first Sri Lanka paper explored the linkages between water, health and poverty and presented a conceptual framework which was used to analyze the results of previous studies. Sri Lanka's dry zone was the geographic focus of the second paper, which focused primarily on the linkages between irrigation and poverty. We now look at some of the conclusions from each of the studies and the insights they, as a whole, can provide for future agricultural water/poverty research and policy.

The case study of Nepal, one of the world's poorest nations, showed clear geographic and demographic differences in poverty rates within the country. Rural poverty was higher than urban poverty, and poverty in mountainous areas was higher than in lowlands. Even given the "natural" disadvantages of rural, mountainous regions, the study found fairly strong evidence to show that access to water reduced poverty. Agricultural access was found to increase crop production and commercialization, resulting in increased food security and cash income. Similarly, domestic water access decreased labor required for water acquisition, thereby increasing time for other productive activities. When used to produce hydropower, water also reduced labor requirements, especially for women, in agro-processing by powering traditional and modern mills; and electricity generated by local micro-hydropower reduced expenditure on fuel, and lowered smoke levels and fire potential in homes. While water provision was related to educational achievement, the impact varied by sex, and the form of access. Good access to domestic supplies made it more likely that girls, traditional water gatherers, would have time to attend school. Access to agricultural water made it more likely that boys would attend school, because school attendance for boys is related to family income, which tends to be higher when agricultural water is available.

While water was generally associated with poverty reduction, the Nepal case study also highlighted instances in which it had adverse impacts. For example, irrigation use sometimes increased run-off, causing deterioration in cultivated lands as well as increased risk of landslide. In addition, irrigation diversions were responsible in some instances for reduced in-stream flow which negatively impacted aquatic life and the livelihoods of downstream residents. Poor irrigation drainage and sanitation systems for household water also increased incidences of water-related diseases such as malaria. While water-generated electricity and mill power did provide overall benefits, access to those benefits was not evenly distributed amongst community members. In general, access to water-related benefits was associated with monetary or labor contributions to the

hydropower systems, contributions which the poorest households sometimes could not make. As a result, the development of water services may have in some cases widened income gaps, reducing the relative power, and potentially, the income of the poorest people.

The case study on Pakistan focused on the Turbat district, one of the most impoverished districts in Pakistan's poorest province, Baluchistan. The regional climate is arid and generally receives only 150 mm rainfall, annually. However, the water supply system has been made substantially worse in recent years due to drought. The focal point of the study was the traditional *karez* system of irrigation and its ability to meet the needs of farmers during the highly water-stressed period. One of the main advantages of the karez system is that it is normally able to deliver water year-round, because it utilizes groundwater systems less directly connected with recent precipitation levels. The value of water provided by the karez is especially clear when one examines what happened when the system failed. Some of the people surveyed for the study had been financially secure prior to the drought, but were reduced to destitution as the system dried up. Not surprisingly, it was those who were in the worst financial position when the drought started, that were least able to cope.

While on the surface, the study of the karez system seems simply to suggest that the poverty problems of Turbat were only exacerbated by drought, further examination shows a more complicated story. In particular, evidence was given that the failure of the karez system was hastened by the growth of mechanized tube-well pumping, occurring at unsustainable rates, which had lowered groundwater levels. Tube-well owners appear to have already been amongst the most well-off members of the population when the drought began, and their position as water suppliers to former karez users only further strengthened their status in the midst of the drought. While those who needed to buy water from tube-well owners were hurt by the untimely demise of the karez, the study found, not surprisingly, that households whose incomes were diversified away from agriculture, were most able to cope with the drought, again showing that the provision, or lack thereof, of water will have differing poverty impacts on differing strata of societies. Similarly, the study found that the role of water had differential impacts on the poverty of individuals within households and suggested that it was the traditional women in Turbat who probably suffered most under the changing system. Not only did the women have to exert more energy and resources to collect water from distant tube-wells, they were now forced to give up their privacy and dignity and go against societal norms by venturing away from home to gather water.

The study suggests that nurturing community support and mobilizing communities' organizational, financial, and human resources for integrated management of existing water and other natural resources must form the core of any drought mitigation strategy, and karez rehabilitation should be one of the key foci of this strategy. Strategic responses that must complement karez rehabilitation include water conservation to enhance the benefits of available water supplies and the development and promotion of crops that require less water. Part of the long-term integrated response should include analysis of successful efforts to integrate social, economic, and scientific research. Integrated response requires that local, provincial and central-level policies and practices be consistent and integrated with each other.

The first Sri Lanka case study took a slightly different approach from the previous two studies. First, it focused on the role of health in the water/poverty nexus, and second, it provided a conceptual framework for understanding that role. According to the framework, health and poverty have a two-way relationship in that, poverty can be both a cause and a consequence of poor health. Thus, the provision of water can contribute to poverty reduction if it has a positive impact on health, and can contribute to the continuation or exacerbation of poverty if it has a negative impact on health.

The study then used case studies from Sri Lanka to find examples as to where the water/health/poverty alleviation linkage was positive and where it was negative.

The study cited a number of instances where water provision was related to poor health and hence, the persistence of poverty conditions. For example, pollution of surface and groundwater from agricultural and industrial sources were associated with health problems. Similarly, the study noted that the incidence of malarial and other water-borne diseases is often associated with the provision of irrigation water. Despite these negative findings, the study suggested that overall, the linkages between agricultural water, health and poverty alleviation are in fact positive, largely because of an indirect relationship. The positive linkage is not caused so much because, water directly contributes to healthier communities, but rather, because, the provision of irrigation water is associated with higher incomes. Higher incomes give households the capacity to improve their nutrition levels and take preventive and curative measures to address actual and potential health problems, including those initially caused by water provision. As a prime example of this relationship, a previous study was cited in which it was found that the provision of irrigation services actually decreased the incidence of malaria, because, the income effects (e.g.,housing improvement) from irrigation outweighed the environmental effects (e.g., more water for mosquito breeding) which promoted the vector.

The study concludes that (1) Sri Lanka has experimented with a range of social welfare programs targeted at the poor, some more effective than others but all with many deficiencies in absolute terms. A close analysis of these experiences will enable identification of the weaknesses and their elimination from other targeted schemes for Sri Lanka as well as other countries of the region; (2) the emerging water policy initiatives must take note of the need to effectively regulate ground water; (3) irrigation water is often a direct source of drinking water as well as a means of recharging ground water. An integrated view needs to be taken in planning these systems as well as managing them; and (4) proper management of irrigation systems is very important from a point of view of minimizing degradation of natural resources which affect people's livelihoods, but also from the perspective of minimizing and controlling associated disease-causing mechanisms. Finally, the study emphasizes on the role of partnerships in carrying forward these lessons for practical action for on-ground impact.

The second case study based in Sri Lanka focused on the Hambantota district located in Sri Lanka's "dry zone". This district is characterized by its predominantly rural and agricultural nature, below-average rainfall and above-average poverty. It is also an area that has seen a substantial change in the agricultural sector in recent decades, particularly as related to increased population densities and a concomitant decrease in per capita agricultural land. The case study provided examples based on previous research, related to irrigation water and poverty linkages in the district. The results suggested that the provision of irrigation services in the district was associated with reduced poverty levels. This was because, in the first instance, irrigation allowed an increase in land productivity, increasing yields, cropping intensities and farm profitability. While such improvements may have accrued largely to the landed class, it was also shown that irrigation provision increased labor requirements and wage rates, thereby also providing benefits for the landless and land-poor.

While overall the study seemed to indicate that irrigation had a net positive impact on poverty alleviation, like the other studies, it also highlighted the negative aspects. Some of these negative aspects included land degradation brought about by salinization, destruction of lagoon prawn fisheries, and reduction in environmental services as reflected in a decrease in aquatic bird life. It was pointed out that many of these negative impacts seemed to be focused on the poor. While not

specifically examined in the study, it also appeared that most of those who received some harm from the provision of agricultural water were not those sharing in the benefits. In other words, the negative impacts of irrigation were felt off-site, away from the irrigation systems, an outcome with clear equity implications.

In summary, all of the studies in this volume were in agreement that agricultural water and poverty were intricately linked. They were also clear that the nature of that linkage was not straightforward. In general, all the studies seemed to suggest that agricultural water was, on the whole, associated with poverty alleviation. However, all of the case studies also found that the provision of agricultural water had at least some potentially negative poverty-increasing aspects. Furthermore, the studies found that the distribution of costs and benefits from irrigation services was not uniform, and that it was often the most disadvantaged members of society who benefited least or were hurt most by agricultural water's negative side-effects. If a single lesson can be drawn from these four case studies, it is that researchers, policy makers and project implementers - public or private - must have a deep understanding of the many, often hidden, linkages between water and poverty if potential poverty reducing impacts of agricultural water are to be realized, and the benefits of agricultural water equitably shared.

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