Annex 7

Integrated Development and Management of Water Resources for Productive and Equitable Use in the Indrawati River Basin, Nepal

(Summary and Synthesis of Four Case Studies)

International Water Management Institute, Nepal
and
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ACRONYMS

CDO	Chief District Officer
DDC	District Development Committee
DOI	Department of Irrigation
DWRC	District Water Resources Committee
Ghatta	Traditional water mill
ISP	Irrigation Sector Project
Khola	river (local term)
Kulo	Irrigation canal (local term)
Muhan	Intake or source of water
MWSP	Melamchi Water Supply Project
NRs	Nepalese rupees
RBDPM	River Basin Development Planning and Management
REDP	Rural Energy Development Programme
UC	Users' Committee
VDC	Village Development Committee

Executive Summary

Recently, the Government of Nepal launched a large-scale interbasin water transfer project to divert water out of the Indrawati river basin (Melamchi river) to meet the drinking water needs of her capital, the Kathmandu city, located in the Bagmati river basin. The total cost of the water diversion project is US$464 million spread over 7 years. Recently, several case studies were conducted in the Indrawati river basin and the Melamchi river, a subbasin of the Indrawati river basin, to assess potential local impacts of the bulk water transfer out of the basin, funded by the Ford Foundation/New Delhi. In view of concerns regarding the sustainability of the interbasin water transfer and its impacts on the exiting local water use, this study summarizes the preliminary assessment of the project impacts and the local water use in the basin. Then, it analyzes constraints and opportunities of managing the water resources in the principle of Integrated Water Resources Management (IWRM). This involves an analysis of economic, financial and productive uses of water resources giving due consideration to social equity, environmental and ecosystem dimensions of the water use decisions in relation to the water diversion project.

This report is a summary and synthesis of four other detailed case studies carried out in the Indrawati river basin by IWMI/Nepal and Water and Energy Commission Secretariat/Nepal (WECS/Nepal) during the project period, funded by the Ford Foundation/New Delhi. The four detailed case studies[1] conducted in the basin were on the topics of "Formal and Informal Water Institutions," "Water Accounting Status," "Social Exclusion and Inclusion," and "Process Documentation Research (PDR) of the Melamchi Water Project." Only the major findings and key issues of these case studies are summarized in this report. Detailed case studies are provided in the project annex report 10.

This report documents the preliminary assessment of major concerns in the basin in relation to a) the Melamchi water project, in particular the water diversion project's likely impacts on economic and social fronts, and local water use decisions, and b) the local environment. The major findings of the IWMI and WECS project in Nepal are summarized below.

A. Melamchi Water Project and Its Impacts

Because of the acute water scarcity in the Kathmandu city, recently, the Government of Nepal initiated the Melamchi interbasin water transfer project to meet the long-term drinking water demands of the Kathmandu city. Details of the Melamchi project are provided in chapters 3 and 4 of this report, and separately in annex reports 10.

From the perspective of water use and availability, the Indrawati river basin is an open basin with less than 4 percent of the total water inflow being process-consumed. In an average year, nearly 90 percent of the utilizable water outflow, equivalent to 3,082 million cubic meters (MCM), moves out of the basin as runoff to downstream. The Melamchi interbasin water transfer scheme is planned to divert 1.97 m^3/sec, i.e., 62

[1]The four case studies were published by IWMI/Nepal as project documents and circulated to concerned water sector institutions and policy makers in Nepal. Details of these IWMI/Nepal project reports are given in the literature cited section of this report.

MCM of water per annum, which is about 2 percent of the total annual river runoff from the basin. There is a potential to harness the available water within the Indrawati basin. However, lack of adequate storage (reservoirs) and low level of developmental activities in the basin are binding constraints. More than 90 percent of the river flow occurs during 4 to 5 months of the monsoonal season whereas there is a seasonal water scarcity situation in some of the tributaries during the dry months (January to May). In 9 months of the year, the average river flow is more than 25 m^3/sec (Mishra 2000). The water flow in the basin reduces to an average of 4 to 5 m^3/sec from January to April, which is higher than the planned water diversion by the Melamchi project (1.97 m^3/sec). Details of the water accounting procedure and the water balance status are provided in chapter 3 of this report, and in project annex report 10.

Local Impacts and the Compensation Package

The local communities are not much aware of the Melamchi water transfer project and its likely impacts on their water use activities due to inadequate involvement of the local communities in the project planning process and restricted interactions with the local stakeholders by the project officials. The project intake site[2] is located in the interior of the mountain range, not inhabited by any major settlement. No major intake of irrigation systems or water-related projects are located within 1 km downstream of the proposed intake site. Two other small tributaries join the river within 2 km downstream of the project intake site, providing adequate river flow.

The Melamchi project has a compensation package of US$18.33 million to mitigate the adverse effects and compensate for the project-affected households. Compared to previous water projects in Nepal, this scale of compensation package and involvement of local NGOs in the project work are unprecedented. Recently, UNDP, IUCN and other international agencies working in Nepal were also involved in formulating the project compensation packages in the basin. It is hoped that this would ensure a better implementation of the compensation package in the water-supply basin.

Environmental Impacts

The average water flow in the Melamchi river is well above the planned water diversion. During the monsoon the river flow is 25 times more than the planned water diversion by the project (Mishra 2000). The Melamchi project has a plan to release a minimum flow of 0.4 m^3/sec downstream of the intake, even during the dry season to maintain the environmental and natural freshwater ecosystem in the basin. This minimum environmental river flow is expected to minimize the potential adverse environmental impacts on the freshwater ecosystems. All (EIA) studies in the past have given a positive rating for this project. In addition, the proposed water diversion scheme is a runoff type of river project with the intake structure (dam) whose height is less than 6 m. This will minimize the project's adverse impacts on freshwater river ecosystems with limited obstruction of the natural river flow.

[2] The construction work (intake construction) has just begun in the basin.

B. Melamchi Project and Institutional Issues

The Melamchi Water Supply Project represents a situation that is common worldwide. The increasing demand for drinking and sanitary water from cities is diverting water out of the surrounding rural sector water uses, both within and outsides the local basin area. The existing water institutions in the Indrawati basin are mostly informal in nature and are based on traditional or customary practices (customary law). They are insufficient to deal with issues of formal water rights, river water reallocation, bulk intersectoral reallocation, and project-compensation-related negotiation with agencies from outside (the central government). However, these informal water institutions may provide a means to buffer the increasing stress brought about by the diversion of water out of the basin.

Such a bulk water transfer out of the basin is likely to change some of the local water use practices, which may create some stress on traditionally practiced institutional mechanisms for water allocation and on conflict resolution. Such water stress would be more pronounced immediately downstream of the project intake site during the dry season from January to May, when the river flow would be only about 10 percent of its peak flow level in the monsoonal season. The question then is whether these existing community-level institutional arrangements can cope with the institutional crises brought about by the external shock. The higher seasonal fluctuation of river flow is one of the major problems for effective use of water resources available in the basin.

The local water institutions were not consulted much during the Melamchi project formulation and the project planning stage, which was formulated at the central-level governmental authorities. However, consultation with local stakeholders, including the local institutional stakeholders, has recently been increased during the project implementation stage. As a result, several community level stakeholder consultation meetings were held in the recent past, also involving local and national-level NGOs and representatives from international NGOs, like IUCN, and from the UNDP functioning in the nearby areas.

C. Local Water Institutions in the Basin

The existing water allocations across the sectors are mostly governed by the customary water law, based on the informal traditions and need-based allocations. The local customary law provides first priority to the irrigation need because of the agricultural-based livelihoods of the communities. This is acceptable as long as the basin remains open with a low level of water use. However, the situation may demand alternative water institutions and allocation practices, as the development of other water uses would increase. Other minority water users, such as *ghatta* (traditional water mill), water mills, and micro-hydro owners, are increasingly pressing for change in the existing informal arrangement and to make the water allocations more transparent and formal, which would protect their water rights intact during the water-scarce times. The growing competition among various local uses, and the need for bulk water transfer out of the basin may provide enough incentives to all local stakeholders in the community for institutionalization of appropriate and formal water-allocation mechanisms, for effective management of water resources in the basin.

There is a lack of coordination among various local institutional stakeholders for managing the water resources in the basin. Some of the local-level formal stakeholders are the District Water Resources Committee (DWRC), the District Development Committee (DDC), the Village Development Committee (VDC), NGOs and other water users group (FMIS). The statutory functions of these local stakeholders on the allocation of water resources are not clearly defined in the National Water Resources Act (1993) resulting in conflicts among the formal local water institutions over their statutory roles and functions in the district. The National Water Resources Act (1993) has given the DWRC greater authority on decision making on water allocations in the district. However, in reality it is a virtually nonfunctioning agency at the moment. In the present setup, the DWRC is restructured with more representation from local water users and the DDC so that it could potentially also function as a coordination mechanism for intersectoral and interdistrict water allocation, and possibly as a rudimentary form of river- basin (or subbasin) planning initiatives in Nepal, with the least shake-up to the other administration and political institutions in the country.

The requirement of compulsory contributions of cash (and labor) to receive the services from new water use has indirectly contributed to the exclusion of some of the poor households from using the services of the new water project, like micro-hydro and the new irrigation system. The service payment for the project can be adjusted, based on the need of the communities by providing a targeted subsidy from the DDC and the VDC, from their regular contribution to set up the project without any additional burden. Improved consultation of local stakeholders and the community-group decision-making process would enable the marginal households to share the project benefits and water use activities.

The water rights (prior appropriation rights) of the first users are often encroached upon without giving any compensation to them. This is particularly seen in the case of conflicts between the ghatta and the irrigation water uses in the community. The water rights of the ghatta owners, who are usually marginal households in the community, are not as firm as those of others in the community.

D. Major Policy Implications

While planning such a bulk water transfer project, local-level consultations, building up of local confidence since project planning and due sharing of project information with the local communities would help avoid the public skepticism against the project. Local-level consultations, even during the implementation stage, would greatly enhance the local-level support for the project and ensure the long-run success of the project.

There is a need to have a detailed monitoring of the river flow of the Melamchi river and its tributaries surrounding the proposed intake site. This is important, particularly for documenting the dry-season flow in the river when the river flow is reduced substantially. The detailed water balance study in Melamchi could also help a) get rid of the water-flow-related skepticism associated with the Melamchi project, and b) timely restructuring of the project compensation package if there is such a need.

Informal institutions are now capable of implementing water allocations for the present water uses in the basin. However, it is expected that the appropriate formal institutional mechanism of water allocation could evolve to manage the external stress

caused by bulk water transfer out of the basin. These developments and dynamics of institutional evolution should, nevertheless, be closely monitored to understand the complexities of institutional development and institutional adjustment in the changing context.

The establishment of formal water rights for the existing water users in the basin community, even by provision to registration at VDC or at DDC, would help, to a large extent, to protect the minority water use rights while implementing a new water project, or reallocation of water to the community. This would also reduce the transaction costs involved in settling down the project compensation package and resettlement programs, etc. This, in turn, would also encourage local community and outside investment in new water projects in the basin, like water mills, micro-hydro projects, etc., by reducing the huge transaction cost involved in the compensation-negotiation process.

There is a need to have a proper assessment of the economic and societal benefits (costs) of water transferred out of the Melamchi sub-basin to Kathmandu, including the social and environmental costs (benefits) attached to such an interbasin water transfer scheme. This information will be useful for designing an effective compensation packages and a sharing mechanism for project benefits. This sort of information will be useful not only for the Melamchi project, but also for any other future water infrastructure projects in Nepal, in particular, for the estimation and quantification of the net social gain (attachment with cost) of such bulk water-transfer projects.

1. Introduction

This project report provides a summary and synthesis of four more detailed case studies earlier conducted in the Indrawati river basin[3] by the IWMI/WECS team and funded by the Ford Foundation/India. They are on the following topics "formal and informal water institutions (Pant and Bhattarai 2000)," "water accounting and water balance" in the basin (Mishra 2000) "process documentation research (Devkota and Bhattarai 2001)" and exclusion and inclusion process (Pun 2000).

The Indrawati river basin has recently been targeted for several new water development projects, including the interbasin the Melamchi water diversion project, which plans to divert 1.97 m^3/sec of water out of the basin to meet the growing urban drinking water needs of the Kathmandu city. Details of the Melamchi water diversion project are given in chapter 4 of this paper. This scale of water diversion out of the basin may produce wide dimension of external shocks to the locally managed water institutions, to social equity and to the water-related environment in the basin. In this context, this project study report documents the existing institutional practices, water use activities and water management in the river basin to promote appropriate planning steps and institutional arrangement for Integrated Water Resources Management (IWRM) at the basin level. This study also assessed the anticipated local-level impacts by the Melamchi interbasin water-transfer project, and how the present water institutions in the area can cope with the external shocks brought about by these large-scale water diversion projects. This study takes the Indrawati river basin in Nepal as an example to illustrate key issues and concerns in initiating the IWRM approach in Nepal. This involves analyzing the anticipated impacts on the economic front as well as on social equity on resources use, and on the freshwater ecosystem and the environmental fronts.

With growing population and improvements in living standards, water demand has been increasing rapidly over the last few decades. In many cases, this has led to increased conflicts in water use between water user groups and among various sectors, such as irrigated agriculture, urban needs of water, tourism, industry and other new water-development projects. The need for an integrated approach to water resources management becomes more urgent with growing competition for water among these sectors. Although IWRM is a felt needed at the policy level, in Nepal there is little practical experience and knowledge on how to operationalize such an integrated approach to water-resources management. This research provides insights into developing future policy strategies for integrated development and management of water resources in Nepal.

The Indrawati basin is predominantly an agricultural-based system and its upper basin supplies water to more than 120 farmer managed irrigation schemes (FMIS) that command about 2,100 hectares of agricultural land. Recently, the basin was targeted for various other water uses including hydropower plants and a Melamchi interbasin water transfer scheme to provide water to its capital city, Kathmandu (details on the Melamchi project are given in chapter 4). Moreover, the demand for water in the river basin has been increasing as a result of development of additional water-use activities like water

[3]Details of these case studies are provided in recent IWMI/Nepal and WECS publications, as given in the literature cited section. These case study reports were circulated among the governmental policy makers and other researchers in Nepal.

mills and ghatta, and the need for bringing more land under irrigation to sustain the food demand of the growing population. This increased pressure on scarce water resources from inside as well as from outside the basin calls for an integrated approach to water resources management to enhance productive, social, equitable and environmentally sustainable uses of the water resources.

The Ford Foundation provided a grant to the Water and Energy Commission Secretariat (WECS) under the Ministry of Water Resources, Nepal and IWMI to conduct this study over an 18-month period. The joint research between IWMI and WECS adopted an explorative case study methodology of field research, which included compilation of the existing water use activities in the basin and identifying key policy and strategic issues involved in the management of the water resources in the basin. This study summarizes and provides a preliminary assessment of the water use activities in the basin to facilitate a comprehensive and a more in-depth policy research during the second phase of the study in the river basin, i.e., a follow-up project in the basin by WECS and IWMI.

The second phase of the study is expected to cover issues like water resources development and management systems, development of basin-level institutions in Nepal and detailed social and environmental costs associated with the water diversion scheme. Some of the results and recommendations provided here can be translated into immediate action while operationalization of other policy prescriptions and research agendas may require further detailed studies in the river basin, particularly considering the preliminary assessment and the nature of water-use documentation of this phase of the study

This study basically provides feedback into WECS's ongoing work in project activities on integrated water resources development and management in the Indrawati river basin and in other projects in Nepal. It is expected that the findings of this study can also be equally relevant to the WECS's ongoing task on "Long-Term Water Resource Strategy Formulation in Nepal."

There are several variations on operationalizing the IWRM concept and the scale of hydraulic units to be considered that vary, based on the specific characteristics of the region. Within the IWRM concept, this project study explores the possibility and likely constraints on applying the river-basin management concept in managing the existing water resources activities in the Indrawati river basin. This is also one of the bench mark river basins selected by IWMI in Nepal for the long-term monitoring the changes in water-use activities and sustainability of the river-basin systems.

Research Goal

In the context of increasing scarcity and competition for water uses across the sectors, the overall goal of this research study was to improve productivity of water resources in Nepal's river basins, contribute to poverty alleviation, increase equity in water use and protect the environment through IWRM strategies.

Research Objectives

The general objective of this study was to assess alternative means for increasing and sustaining productivity of water through better management of multiple water uses in the

Indrawati river basin in a way that enhances resources use efficiency and social equity, eradicates poverty and conserves the overall environment in the basin. Within this framework, the specific objectives of the project case studies in the basin were:

1. Increased understanding and awareness of the existing formal and informal arrangements for managing water, and their many uses and stakeholders of water within the river basins.
2. Preliminary assessment of proposed and committed development initiatives in terms of likely benefits derived from the water resources, and an understanding of the potential impacts on present stakeholders.
3. Provision of key information and recommendations for developing integrated water resources development and management strategies that combine the objectives of resources use productivity, equity and conservation of natural resources.

Research Hypotheses

It is expected that proper application of IWRM will enhance productive water use, equity and conservation of the local environment. The hypotheses and research questions of this study relate to four major issues in water resources: the need for integration of different water use sectors, the recognition of existing formal and informal arrangements of water resources management, the involvement of stakeholders at all levels and social equity issues involved in water use decisions.

Need for Integration

A major weakness in the water resource planning in Nepal has been the lack of integration of the workings of various departments/agencies associated with the sector. Sectoral plans developed in isolation from one another tend to ignore the interlinkage and upstream and downstream effects of water uses. It is expected that the ongoing and new development projects in the basin (such as, the Melamchi water scheme, and three hydropower plants) will further increase competition for water, which will have a direct impact on the existing water use patterns in the basin. A knowledge of these existing water use patterns is a prerequisite to avoid or mitigate adverse impacts of increased competition for water. This study fits within this context of better management of various local uses of water resources in the river-basin context.

Existing Water Institutions

The Indrawati basin has a long history in farmer-managed irrigation schemes (FMIS). Over the years, dependable means of cooperation and water-sharing mechanisms have evolved by trial and error. We think that these traditional systems of cooperation and informal institutions provide a reliable base for future institutional development. New systems for developing and managing water resources must be based on an understanding of the existing formal and informal arrangements. Without this, the new systems developed could be both ineffective and detrimental to the interests of the present users.

Involvement of Stakeholders

Water development plans formulated at central level often disregard the local water use patterns and informal institutional arrangements already in place. The local community is usually informed about the new development project plans only after the major decisions have been already taken at the central level; yet, it is the local population that will directly benefit or bear the negative impacts of new developments. Our research hypothesis is that within the local community, office bearers and community leaders are relatively well informed concerning development efforts and, consequently, they have more opportunities to influence plans and benefit from them than the majority of the basin's population. Typically, poorer and more vulnerable groups have less access to this kind of information. Mechanisms to involve stakeholders at all levels are an essential element in water resources development to enhance the social equity and better representation of local stakeholders in the resources use decisions.

Equity Dimensions of Water Uses

Not all people benefit equally from development efforts. We hypothesize that some groups get more benefits of development projects while others, especially the poorer and less-visible groups in society, are left out of the process. At the same time, it is likely that in an environment of growing competition and water scarcity, poor and marginal groups will lose more than others. Well-organized sectors are likely to have better opportunities to claim water than the traditional farming sector. Insights in the "inclusion" and "exclusion" process in water development would help avoid potential negative impacts of increased competition for water on the already vulnerable groups. Such in-depth analyses would provide information for designing appropriate benefit-sharing mechanisms among the stakeholders.

Research Questions

Considering the four key issues discussed earlier in the section on research hypotheses and objectives, the following research questions were formulated to carry out the detailed case studies in the Indrawati river basin. They are:

1. Who are the existing water users, and what are the patterns of water uses differentiated by sector, public and private uses, gender, and income level? Who is left out?
    - The answers related to this question pervade several chapters of this report (chapters 4, 5 and 6). More specific discussions can also be found in other IWMI/Nepal project documents like Pun 2000 and Pant and Bhattarai 2000.

2. What is the degree of scarcity and competition for water resources among different uses?
    - **Water accounting chapters of this report (chapters 3 and 4) provide answers to this question. The detailed case study reports can also be found in the water accounting case study document published by IWMI/Nepal (Mishra 2000).**

3. What are the formal and informal arrangements for managing water in its different uses within the basin? What are the water rights arrangements and means for conflict resolution in the basin?
    - Detailed descriptions and answers to this question are found in chapter 5, on water institutions, of this report. More can be found in IWMI/Nepal project document (Pant and Bhattarai 2000).

4. What are the possible impacts of proposed future developments on water use patterns and the degree of water scarcity? Which sectors and/or water use groups in the basin will be affected? How do different user groups respond to this? Is there a difference in response between classes and gender?
    - The descriptions related to this question are provided in several chapters of this study report (chapters 3, 4, 5 and 6). Detailed descriptions can also be found in other IWMI/Nepal project documents (Mishra 2000; Devkota and Bhattarai 2001).

5. What processes may lead to the "inclusion" or "exclusion" of different stakeholders with regard to recent and proposed development initiatives?

6. How can interests of disadvantaged groups be better protected and served?
    - The answers pertaining to this question are reported in chapter 6 in the study. The detailed case study report (Pun 2000) is published by IWMI/Nepal.

Research Methodology

This study adopted an exploratory case study approach of research methodology to carry out the field study in Nepal. The unavailability of the detailed field-level data on water uses among various sectors, and the informal nature of the functioning of the local-level water institutions, compel us to adopt such an exploratory and participatory data collection methodology. This is the first phase of the study to have compilations of the large sets of information to facilitate another in-depth study in the second stage of the project, which would cover topics on water institutions, environmental and economic impacts of the water development projects. Therefore, the nature and scope of the study in this phase have to be judged considering these limitations.

Study Activities

The detailed field study on the Indrawati river basin involved the following major exploratory activities:

1. Initial assessment of the present resources base in the basin.
2. Assessment of water use patterns, and the degree of water scarcity and competition.
3. Inventory of formal and informal water user organizations and their legal status regarding water rights. Assessment of formal and informal arrangements and institutions related to water resources management and conflict resolution.

4. Inventory of new water development projects and assessment of possible impacts on present water use patterns. Gain insight in the inclusion and exclusion processes in the proposed and ongoing development efforts.
5. Assessment of the existing water uses and water balance, and carrying out the water accounting process in the basin.
6. Collection of the secondary level information on the Indrawati river basin, as available in Nepal.

These activities partly overlapped in time and scope. WECS and IWMI research teams jointly carried out the field studies and report preparation tasks. In the research process ten local national researchers, who formed a team, were not only involved at various stages of the project in Nepal but also got themselves trained in the process.

Due to the exploratory nature of the study and the data constraints, a comprehensive river-basin management plan for the Indrawati river basin, based on IWRM principles, could not be prepared in the first phase of the project study. Instead, we think IWMI and WECS/Nepal will soon analyze this task in detail, in the second phase of the study in the basin. The information collected and compiled here during the first phase of the project study will be very useful for any further study and strategic thinking in the river-basin planning exercises in Nepal.

In addition to providing a synthesis of the major findings from four previous separate case studies, this report also summarizes the key policy and strategic issues that should be addressed in relation to the IWRM in the Indrawati river basin, and in the Nepalese context in general. This involves summary and synthesis of key recent worldwide literature on IWRM and Integrated River Basin Planning Management and Development (IRBPMD) that are most pertinent to the issues in Nepal. In fact, IRBPMD is the organizational function of IWRM, and the key element in operationalization of the IWRM principle. Considering the present water allocation problems in Nepal, the literature was synthesized in the framework of river basin management, its desirability and potential limitations in the context of Nepal.

Outline of the Study

This study provides answers to the specific objectives and research questions raised in the earlier sections. This report has been designed so that each of the following chapters provides answers to several related questions and the specific objectives stated earlier. Each of the chapters has been designed, based on the broad-level related issues involved in the case study, and avoiding duplication of the explanation. Hence, each chapter may provide answers to more than one question raised in the earlier section. .

The second chapter of the report describes the characteristics of the Indrawati river basin, which include physical, hydrological and socioeconomic factors, and water use activities. This chapter provides the broad-level overview of the Indrawati river basin, and its subbasin, the Melamchi river, where the water diversion project work is going on. The third chapter provides the water accounting results conducted at a major confluence of the Indrawati river basin. This chapter also provides answers to questions on the water availability and constraints in the basin. Further, it provides information on the present use level and future development potentials of the water infrastructure. The fourth

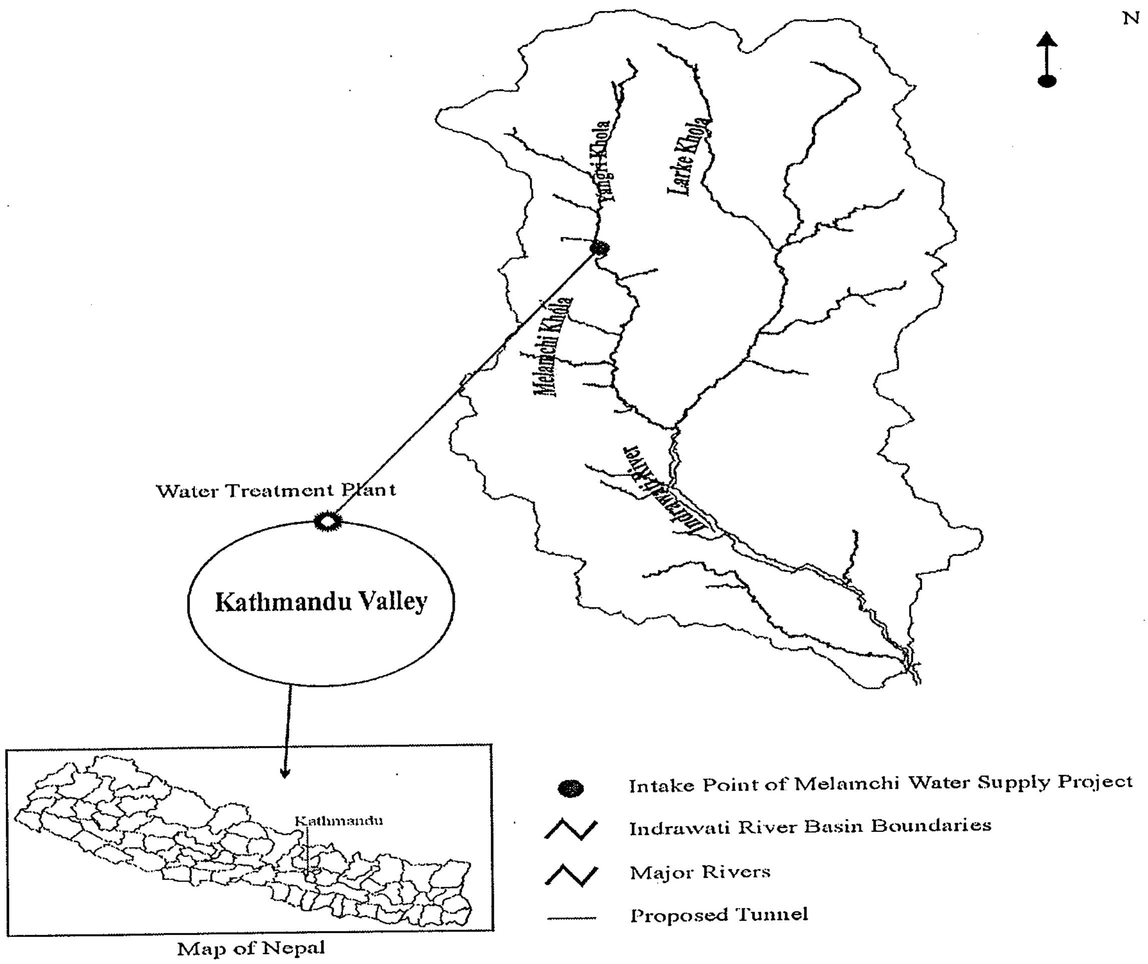
chapter describes the Melamchi Water Supply Project (MWSP), an interbasin water transfer project designed to divert 1.97 m^3/sec of water out of the Melamchi river to the Kathmandu city to meet the city's growing drinking water needs. The fifth chapter of the study explains water institutions, both formal and informal, affecting the water allocation mechanisms of different sectors in the river basin.

The sixth chapter describes the water rights allocations and conflict-resolution mechanisms practiced in the communities, and the need to adjust some of these institutions and practices to suit the growing water uses, and the reallocation of the resources to productive uses. This chapter also provides information on existing water-related conflicts in the basin and the potential of cooperation. The seventh chapter provides an overview of the Integrated River-Basin Planning framework that could be applied in the context of both the Indrawati river basin and Nepal in general. The last section of the study report provides a summary, conclusions and the relevant policy implications inferred from these case studies, and the need for future research in the Indrawati river basin.

2. Characteristics of the Indrawati Basin

The Indrawati river basin is located in the mid-hill of the central region of Nepal, in the Bagmati zone, which originates from the higher snowy range of the Himalayas and joins downstream with Sun koshi (at 626 m msl). The Melamchi water diversion project site is in the Melamchi River in the Indrawati basin about 50 km northeast of the Kathmandu city. The map of the Indrawati river basin including its water shade area is given as figure 2.1. The landscape in the basin mostly covers rugged mountains, with rare sites of flat land where farming is done. The length of the main course of the Indrawati river is about 59 km, covering 124,000 hectares of land. Some of the major tributaries of the Indrawati river basin are Larke khola, Yangri khola, Melamchi khola, Jhyangri khola, Chaa khola, Handi khola and Mahadev khola, shown in the schematic diagram in appendix figure 2.

Figure 2.1. The Indrawati river basin showing the Kathmandu valley.



Among the several basins of the Indrawati river, the Melamchi, Handi and Mahadev river basins are important in terms of water use practices. This chapter describes the salient features and selected characteristics of the Indrawati river basin and the Melamchi river, with focus on physical, hydrological, socioeconomic and current water-use activities. The detailed discussions on the Melamchi river basin along with the Melamchi water project are reported in chapter 4.

2.1 Physical Characteristics of the Basin

The Indrawati river basin is located in the subtropical to Alpine climatic zone in the Himalayan range, overlapping three central hill districts of Nepal namely; Sindhupalchowk, Kavreplanchok and Kathmandu. Out of the 124,000 hectares of the catchment area of the basin, the natural forest area covers nearly 40 percent of the basin.

Less than 3 percent of the total basin area is currently utilized for the farming purpose. The population density of the basin was about 175/km^2 in 1998.

The average annual rainfall in the basin ranges from 3,874 mm at the higher elevation (Sarmathang) to about 1,128 mm at Dolalghat, at the lower elevation zone, with an average annual potential evapotranspiration of about 954 mm (WECS/IWMI 2000). The average relative humidity is about 70 percent, which varies from 60 percent in the dry season to 90 percent in the rainy season. The daily average sunshine is 6.2 hours/day, varying from 3.3 hours/day in July to 8.1 hours/day in April.

2.2 Hydrological Features

Inflow to the Basin

Rainfall and snowfall in the upper catchment area are two major sources of inflow of precipitation into the basin. Annual rainfall in the basin varies from 3,172 mm in a wet year to 2,381 mm in a dry year with an average rainfall of 2,791 mm in an average year.[4] The coefficient of variation of annual rainfall ranges from 10 percent to 22 percent at different stations. An analysis of 20 years of data (1971–1990) indicates that there is very little temporal variation in annual rainfall (Mishra 2000). However, there is a large spatial variation in annual rainfall from the head to the tail reach of the basin. The coefficient of variation of rainfall across the selected parts of the basin ranges from 23 to 43 percent, receiving higher rainfall in the head reach of the basin (Mishra 2000). The average Class-A pan daily evaporation in the Indrawati river basin is 3 mm/day, varying from 1.8 mm/day in January to 4.4 mm/day in August. The annual evaporation is estimated at 1,110 mm in the basin.

The variations of the monthly average discharge of water in the selected three major subbasins of the Indrawati river basin are reported in table 2.1 below. The data in the table indicate that the river flow (discharge) is significantly higher in Melamchi in all seasons compared to other two subbasins that, on average, is about five times higher than in Handi river, and 18 times higher than in the Mahadev river. In addition, there is also a potential to expand the water diversion scheme in the future. A small modification of the intake structures will be sufficient to the additional diversion of water into the project tunnel from nearby tributaries.

Table 2.1. Mean monthly discharges of water in selected tributaries (m^3/sec).

Tributaries	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Avg.
Melamchi	4.17	3.55	3.23	3.42	4.74	16.07	47.70	57.01	43.57	19.09	8.56	5.55	18.06
Handi	0.69	0.59	0.52	0.50	0.64	2.83	8.65	10.65	8.37	3.60	1.74	1.13	3.33
Mahadev	0.23	0.19	0.17	0.15	0.18	0.74	2.35	2.91	2.27	1.0	0.44	0.29	0.91

Source: Rajkarnikar 2000.

[4]There is no gauging station in the upper catchment area (snow peak) of the basin above 4,000 m msl to measure either rainfall or snow pack. Hence, the inflow in the basin is averaged from the available hydrological data measured at downstream stations below 3,000 m msl.

Table 2.1 indicates that there is significant seasonal variation of the water flows in the river, more than 90 percent of the total annual river flows occurring within 5 months of the monsoonal season (June to October). This has large implications for both the annual water use decisions and planning for the water development project.

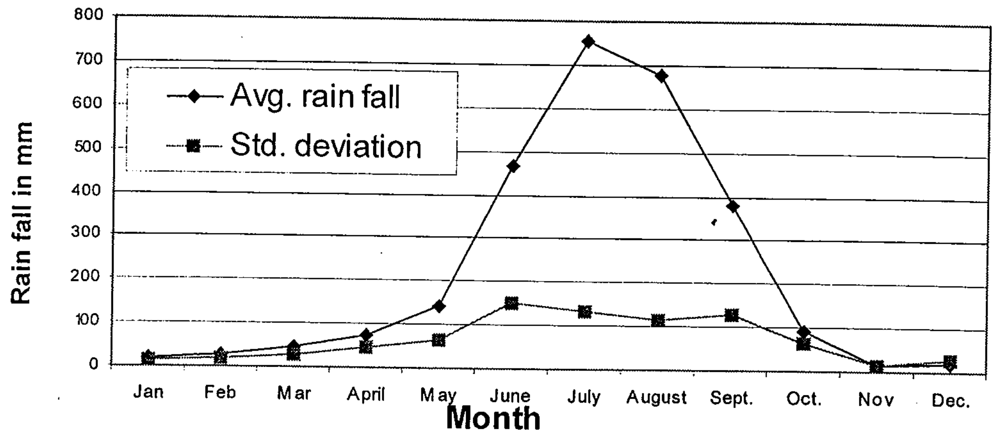
Rainfall

A plot of monthly rainfall for most wet years, dry years, and for the average year over the last 20 years is shown in figure2.2. The salient points revealed from the rainfall plot in figure 2.1 are as follows:

- Rainfall is concentrated mostly during 5 to 6 months of the monsoonal period from the middle of May to the middle of October. July and August are the two months receiving nearly half of the annual rainfall. Just by looking at the rainfall pattern of these 2 months one can say whether a year is going to be a wet, normal or a dry year. This is also the guesstimate adopted by the local community in the basin.
- Rainfall during the dry period of 6 months (November to end of April) is only about 7 percent of the annual rainfall, and it does not vary much among wet, dry and/or average years.
- Monsoonal rainfall is the major source of inflow so that there is a very high fluctuation in the river flow in the basin.
- The low level of water infrastructure (stage) in the basin further compounds the problem where a major portion of water goes out of the basin as runoff without much beneficial use in the basin.

A perusal of the rainfall and runoff pattern in the Indrawati basin indicates that about 93 percent of rainfall is concentrated in 5 to 6 monsoonal months the from the middle of May to the middle of October and, consequently, there is considerable surface runoff and flooding during the monsoon. During the other 6 months of a year (November to April), there is very little rainfall but there is a sizable flow in the river because of the snow melting process in the head reach of the basin. The Indrawati river is a perennial type, so that a significant amount of water is available in the basin even during the dry season (detailed description in Mishra 2000). Besides, during the dry season, crops and vegetation in the basin use the soil water stored in the upper mantle while the groundwater stored underneath the upper mantle contributes to the dry-weather flow in the river.

Figure 2.2. Comparison of 20 years' average monthly rainfall in the Indrawati river basin, 1971–90.



2.3 *Socioeconomic Activities*

The Indrawati river basin has been a target for several water development projects in the recent past. The Melamchi Water Diversion Project and the Indrawati Hydropower Project are two major projects on the list. The Melamchi Water Diversion Project, is a mega-scale water diversion project. The nearby location of a water-deficit area, the Kathmandu valley, is the major reason for the initiation of such a large-scale water development project in the Indrawati basin. The other economic development activities in the basin are at a minimum level. Agriculture is the predominant occupation in the area.

Landholding/Management Pattern

The case study found that the average farm-size holding of households in the area is 1 hectare. The landholding patterns and/or the distribution of land along the three major subbasins of the Indrawati basin are summarized in table 2.2. The data in the table indicate a slightly higher proportion of the (relatively) big landowners in the Melamchi area but the difference is not so wide between the two subbasins. The big landowners are mostly from the *Sherpa* community households in the Melamchi river area, whereas Brahmin/Chhetri communities are in the Handi and Mahadev khola subbasins. Mostly the tenant system of cultivation is followed in the region, with more than 90 percent of the cultivable land under tenancy in the *Palchowk Beltar and Bhattar* irrigation systems. The tenant farming was around 80 percent in the *Taruki Besi* and 70 percent in the *Churetar* irrigation systems with mostly dual ownership type of land registration practices. This means that the land is registered in the name of the landowner but the cultivator's name, with tenancy right on the land, is also mentioned on the landownership certificate. Such tenancy rights are legally binding and transferable across generations and remain attached to the land even with changes in the landownership.

Table 2.2. Landholding patterns in study tributaries, the Indrawati river basin, 2000.

Tributaries	Large land owner (>1 ha)	Average landowner (0.5–1 ha)	Smallholders (<0.5 ha)	Landless family	Remark
Melamchi	12%	25%	60%	3%	The landholding category is done, based on the local socioeconomic status
Handi/Mahadev river	8%	35%	55%	2%	

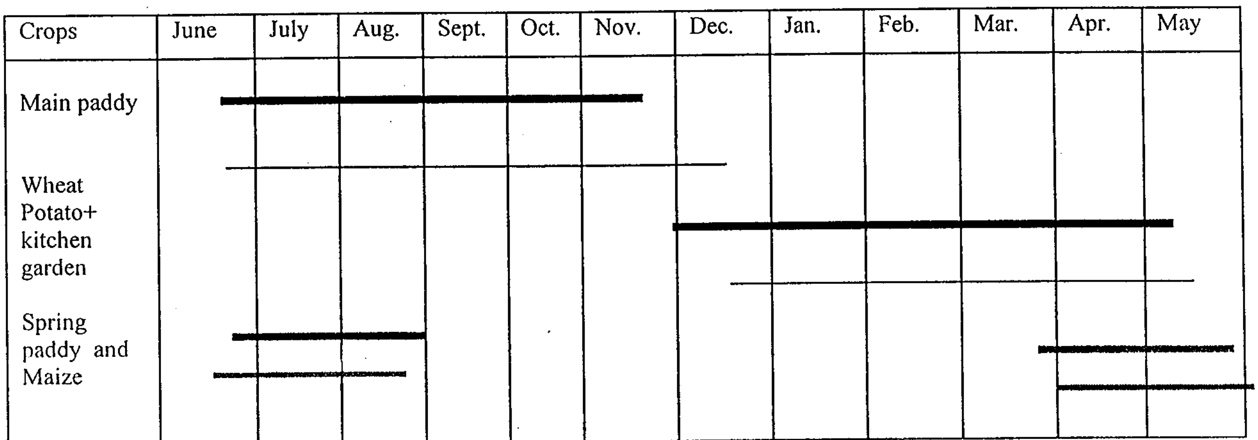
Source: Field survey 2000 (by local interpretations based on PRA data collection procedures).

Cropping Pattern/Productivity

Cereals like rice, wheat, maize and millet are the predominant crops in the river basin. The productivity of main paddy and the spring paddy in the area is in the range of 2.5–3.0 metric tons per ha (according to the PRA report), which is higher than the national average for paddy. The average productivity of maize and millet is 2.45 xx mt/ha and 1.7 mt/ha, respectively. Based on the survey it was revealed that there is no water scarcity for crop production in the basin, except in occasional cases in some portion of the tributaries, mainly because of the lack of adequate physical structures (intakes) or storage, etc.

Paddy is the main crop of the study area. Some farmers even grow three crops per year, two seasons of paddy (summer and spring) followed by wheat as a winter crop, if adequate irrigation is available. Likewise, wheat, maize and potato are other crops commonly grown in the basin area. The commonly prevailing cropping patterns in the Indrawati basin are presented in table 2.3.

Table 2.3. Cropping calendar followed in the Indrawati river basin area, 2000.



Notes: 1. The bold line represents the cropping pattern for the high-altitude areas.
2. The thin line represents the cropping pattern for the low-altitude areas.

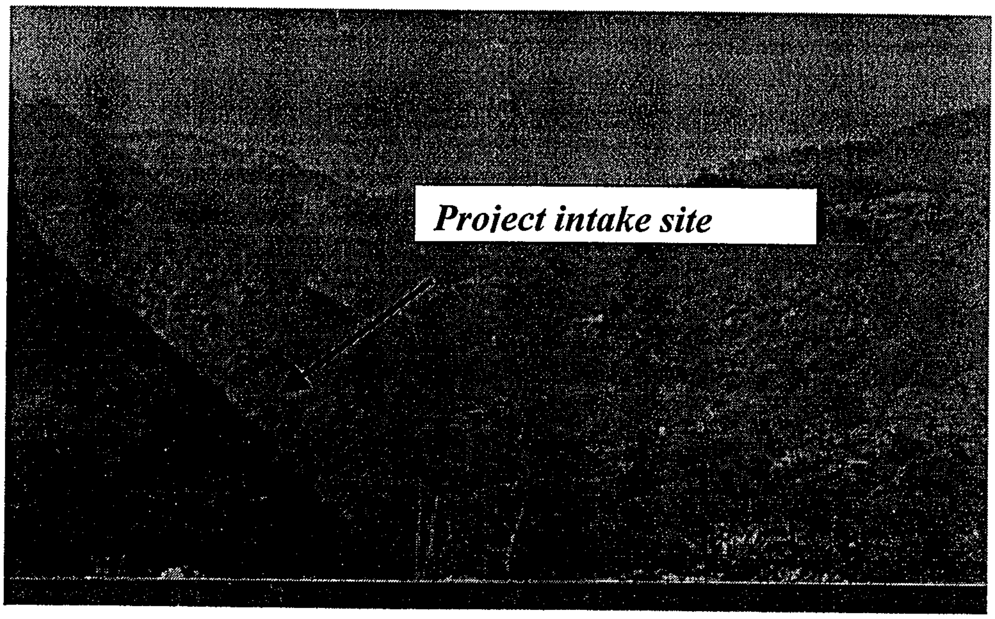
The cropping pattern followed in the lower altitude of the river basin area (1,200–1,400 m above msl) is different from that followed in the higher altitude (1,400 m above msl). In the lower altitude, farmers grow three crops a year, including spring paddy, with

300 percent cropping intensity due to the availability of year-round irrigation facility in the river and tributaries and due to access to enough sunshine in the valley delta. But the farmers in the higher altitude can, at most, grow only two crops a year due to the cooler temperature, even if there is adequate irrigation is available adequately. Farmers cannot grow spring paddy in the upper region as it matures late due to the cold climate, which coincides with the plantation of the main season paddy. The cropping intensity is higher in the lower altitude valley deltas and so is the irrigation water demand compared to other places. Therefore, the net-cropped area and the water stress vary by altitude and so does the water sharing mechanism.

Water Use Activities

Commonly followed water use activities in the river basin are for irrigation, drinking water, animal use, water use by forest and vegetation, hydropower, water mills and so on. All the sectoral uses deplete a certain percent of water, whereas hydropower and water mills add economic value to water without any depletion except in certain portions of the head end. Spring water, or water from relatively inaccessible tributaries, is used for drinking purposes and, therefore, the river diversions will not have any impact on the drinking requirements of the community.

Figure 2.3. The Melamchi project intake site, in Sindhupalchowk district, Nepal.



3. Water Balance Situation in the Basin

This chapter provides a summary of water balance situations in the Indrawati river basin. The detailed water accounting and water balance estimations were carried out in the basin to assess the hydrological consequence of the proposed water transfer out of the basin under the Melamchi project. Due to the limited availability of time series hydrological data, only a simulated water balance study could be conducted in the case of the Melamchi river, downstream at its confluence with the Indrawati river basin. The detailed procedures followed and the results of the water balance analysis can be found in the IWMI/Nepal project report (Mishra 2000).

Water accounting is a procedure to account for the use and productivity of water resources based on a water balance approach. It classifies outflows from a water balance domain (basin/irrigation project/irrigation field) into various categories to provide information on the quantity of water depleted by various uses (Molden and Sakthivadivel, 1999). The results from the water accounting studies are summarized here, first for the Indrawati basin and then for its subbasin, the Melamchi river.

3.1 Indrawati River Basin

The water accounting study at the Indrawati river basin was conducted adopting the standard procedure of water accounting in the river basin recommended by Molden and Sakthivadivel (1999) but with some modifications as per data availability in the basin. The major objectives of the water balance study in the Indrawati and the Melamchi river basin were to assess whether there is sufficient water available in the basin for the water transfer out of the basin, and to analyze its likely hydrological impacts and other major consequences in the basin after the planned water diversion.

Hydrological data from 1971 to 1990 were analyzed for the water accounting task. Three typical years (1985, wet year; 1981, average year; and 1979, dry year) were selected for water accounting computation where the average year relates to average rainfall in the basin. The selection of the typical year was based on the criteria that the annual approximated rainfall values corresponded to frequencies of 25 percent, 50 percent and 75 percent from the average rainfall for wet year, average year and dry year, respectively. All other steps of water accounting like stream flow, storage changes, net flow, depletion and process consumption of water flow were estimated adopting the standard procedures provided by Molden and Sakthivadivel (1999).

The details of water accounting results in the Indrawati river basin for average year, wet year, and dry year are reported in a comparative setting in appendix table 3, and the major findings are summarized in table 3.1 and figures 3.1 and 3.2 below. In addition, the water balance findings are also reported in the standard water balance diagrams, as in figures 3.1 and 3.2. In an average year, nearly 90 percent of the utilizable water resources flows out of the basin as river runoff to the downstream reaches without any beneficial use to the community in the Indrawati river basin (upstream basin). This river runoff estimated to be nearly 3,100 million cubic meters (MCM) of water per annum in an average year and 2,622 MCM in the driest year. Even in the driest year (considered for 1979 over the 20 years), the river outflow (runoff to downstream basin) was about 86 percent of the total intake into the basin (i.e., 2,622 MCM per annum).

Table 3. 1. Findings from the water accounting analysis in the Indrawati river basin, for wet, average and dry years.

S. N.	Component	Subcomponent	Wet Year (1985) Volume (million m³)	Wet Year (1985) % of Net Flow	Average Year (1981) Volume (million m³)	Average Year (1981) % of Net Flow	Dry Year (1979) Volume (million m³)	Dry Year (1979) % of Net Flow
1	Gross inflow	a) Rainfall	3,933		3,461		2,952	
2	Storage changes	a) Surface storage	0		-0.04		0.03825	
		b) Ground storage	0		-81.15		88.15	
3	Net inflow		3,933	100	3,373	100	3,040	100
4	Process depletion	ET of agricultural and related uses	130	3.30	128	3.80	132	4.4
5	Non-process depletion (beneficial)	a) ET forest, grazing lands, homestead, and others	4,87.3	12.40	526.50	15.6	466	15.4
6	Non-process depletion (non-beneficial)	ET barren land, flood plain and water body	84.9	2.20	88	2.6	83	2.7
7	Outflow	Runoff	3,513	89.3	3,082	92	2,622	86
	Sum of depletion and surface runoff		4,214		3,825		3,302	
	Sum of net inflow		3,933		3,373		3,040	
	Calculation error		-281.53		-452.11		-261.95	

Source: Mishra 2000.
Notes: 1. Name of the basin: Indrawati.
2. Area of the Indrawati river basin: 124,000 hectares.

Out of an average annual net inflow of 3,373 MCM, only 23 percent of the available water in the basin (in 1979) was depleted. The remaining 77 percent of utilizable outflow (2,360 MCM) moved out of the basin as river runoff (figure 3.1) without any beneficiary use to the basin community. Even in the driest year (1979), an average of 2,360 MCM of water flow out of the basin without any of it being used in the Indrawati basin communities. The Indrawati river joins with the Sunkoshi river downstream, which itself is already a huge water surplus basin. The utilizable outflow takes place throughout the year, so it is an "open basin." There is a large potential to harness this utilizable outflow and use it productively in the basin area, but there are no major storage reservoirs in the Indrawati basin to utilize the available water resources. Within the area, an increase of, say, 1 percent in the present consumption would probably not even be detected downstream. The other economic activities in the basin are also at a minimum level. Even out of 23 percent of the depleted water in an average year, only 4 percent is process-consumed (for ET requirements for agricultural needs) and the rest is for forests and non-process depletion (for forests and barren land). This indicates that there is a huge potential to increase beneficial process consumption. In addition, it is not the water availability that is the binding constraint in the basin, but the availability of the cultivable land. Only less than 2,000 hectares of cultivable land (flat cropland) are available in the Indrawati basin, with a catchment area of 124,000 hectares. That means, the present cultivable area is less than 1.6 percent of the total catchment area of the Indrawati basin.

Figure 3.1. Water account result in the Indrawati river basin for dry year (MCM).

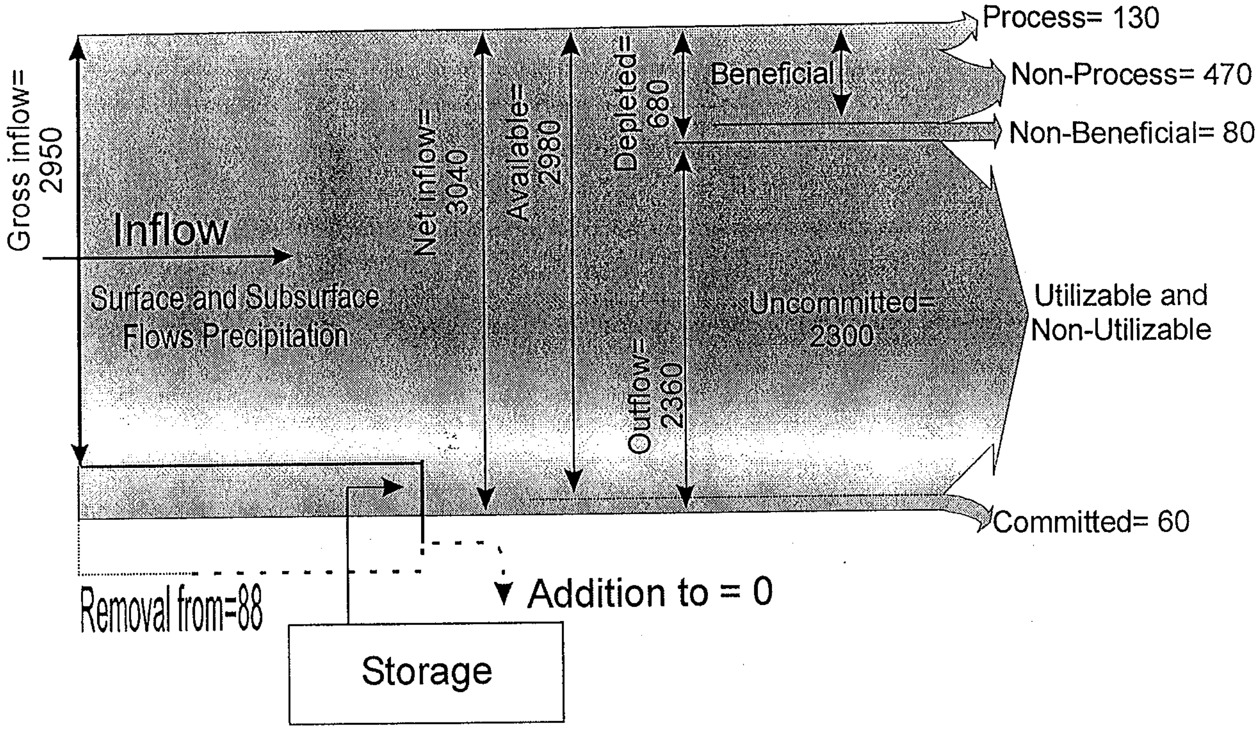
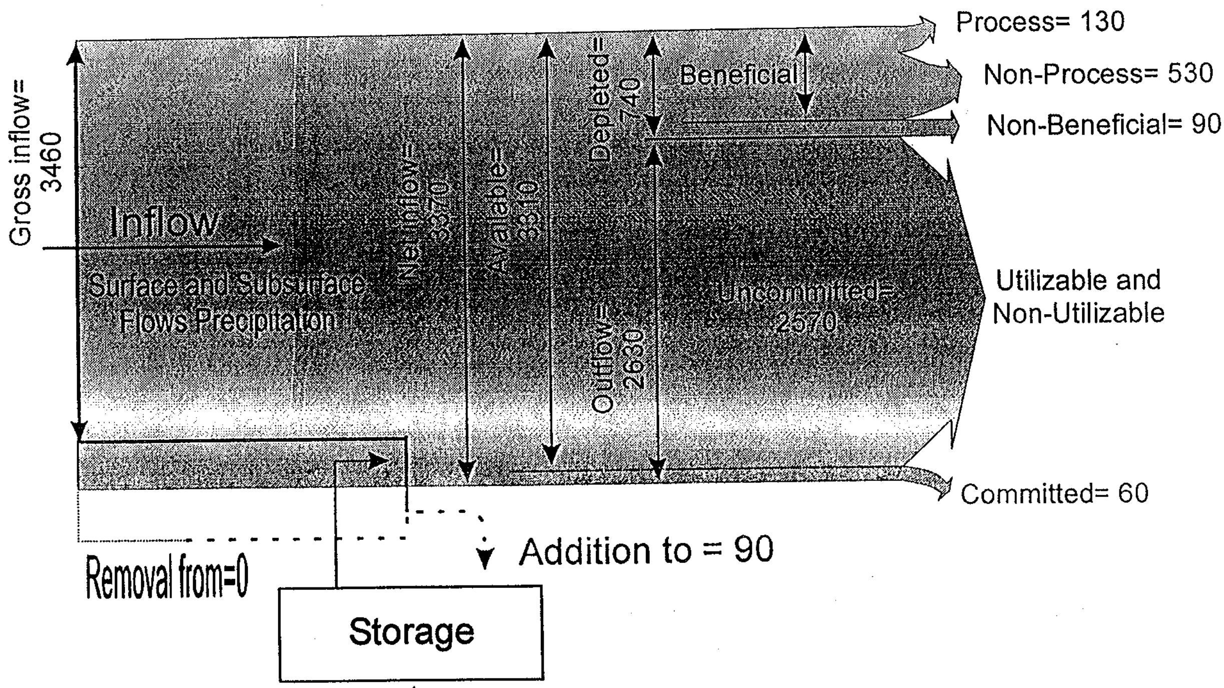


Figure 3.2. Water account result in the Indrawati river basin for average year (MCM).



The scenario of water diversion out of the basin, as proposed by the Melamchi project to supplement drinking water needs of the Kathmandu valley, is also considered in the present water accounting analysis. Considering the local water availability in the Indrawati river basin (2,622 MCM), the proposed water diversion scheme of 1.97 m^3/sec (62 MCM per year) is, in fact, peanuts, compared to the total annual average river outflows from the basin even in the dry year (2,360 MCM). The planned water diversion is less than 2 percent of the total river outflows in the driest year. Therefore, in terms of average basin-wise hydrological consequence of the Melamchi water transfer project, there should not be any major felt impacts, except at the level of tributaries where the seasonal variation of the water flow is higher and the dry season river flow is substantially at low level.

The agricultural productivity of the basin in the dry year works out to NRs 11/m^3, i.e., US\$0.15/m^3 of process-consumed water. This appears to be slightly high considering the cereal and oilseed yields in the basin; however, the water productivity is based on the ET requirement of water. The water consumed per hectare of cultivated crop, works out to only 356 mm, which appears to be quite low. In the ET computation for nonirrigated (rain-fed) crops, effective rainfall and potential evapotranspiration are computed for every 10 days of the crop-growing season. If the effective rainfall is less than the potential ET, computed actual ET is taken to be equal to effective rainfall. What is not accounted for in this type of computation is the depletion of soil moisture from the root zone depth of about 0.5 to 1.5 m. This may be one reason for this apparently higher water productivity of consumed water. Considering the data limitation and the exploratory nature of the study, a simple form of water accounting analysis has been carried out. However, a further detailed investigation is needed to get a better understanding of the water uses and depletion in each sector, particularly in the Melamchi river, in relation to the proposed large-scale water diversion schemes.

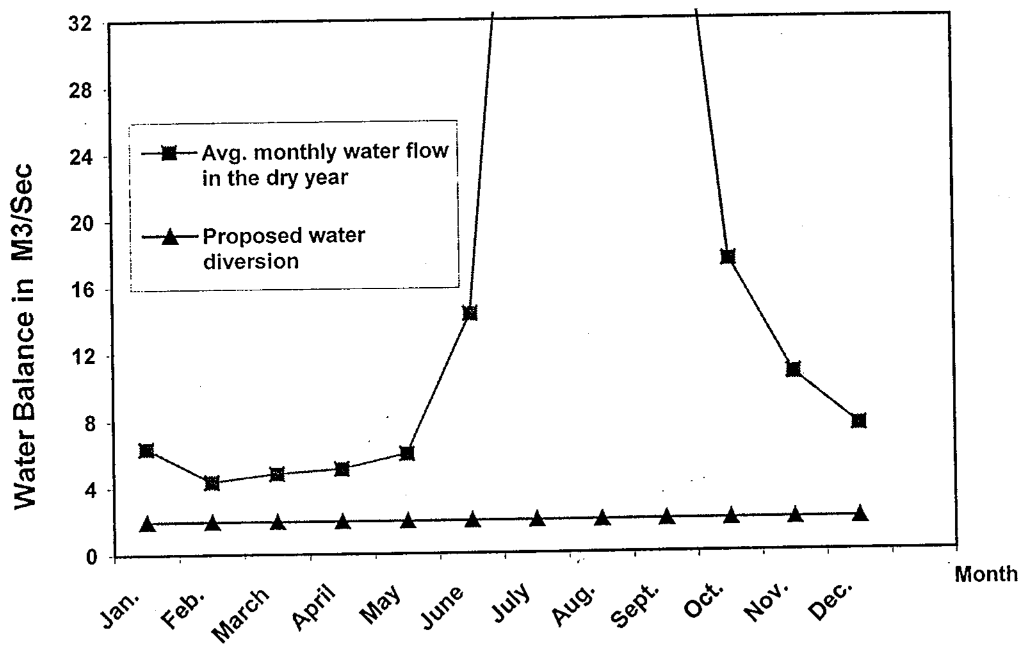
The water balance sheets for the study years reflect that the sum of depletion and surface runoff is slightly higher than the total inflow in the basin. This may be because of erroneous observations of stream flow and rainfall, or insufficient numbers and spacing of rain gauges in the basin area, or it could be because of the difference in estimation of ET. There is a high degree of spatial variation of rainfall from north to south and a large variation of the snowmelt process within the seasons and the years. In addition, there is no rain gauge station or devices for measuring the river flow above 3,000 m msl. Therefore, inflow in the basin is estimated on the basis of average rainfall below 3,000 m msl, which might have resulted in lower inflow than considered in the above calculations. To be on the safe side, while preparing the finger diagrams, the outflow of different study periods was, therefore, reduced by the quantity showing a deficit, to balance the inflow and assess the quantity of utilizable flow.

3.2 Melamchi Subbasin

The water balance study is particularly important in the Melamchi river, considering the proposed water diversion scheme planned for it. Therefore, a simulated water balance analysis was carried out to reflect the overall scenario of water uses in the subbasin, comparing the scenario of with and without the proposed Melamchi water supply scheme. The water balance was studied downstream of the Melamchi basin where it joins

the Indrawati river. Data of 20 years (1971–1990) of rainfall at three rain gauge stations were analyzed (detailed in Mishra 2000) to evaluate the average inflow into the basin. The stream flow data for the long term were not available and, therefore, simulated data of 20 years (Hydroconsult 1996) were considered to generate the outflow at the intake point of the water supply project and at the confluence. A dry year is considered for the computation of the water balance because this is the most crucial and most water-short situation. The water balance result for the study year 1974 (dry year) is presented in appendix table 4, and the final results of the water balance study in the Melamchi river are summarized in figure 3.3.

Figure 3.3. Average monthly water availability in the Melamchi basin in the dry year, 1974.



Source: Based on Mishra 2000.

The water balance analysis in the Melamchi subbasin for a dry year showed that the overall annual depletion (both process and non-process depletion) in the basin is only 209 MCB, which account for about 22 percent of the total inflow of 915 MCM into the basin. Nearly 706 MCM of water flowed annually out of the basin as river runoff, without any beneficial use to the upstream society. Out of the total depletion, the share of process depletion is much less than the non-process depletion, which is similar to the case of the Indrawati river basin presented earlier. These results indicate that a minimum quantity of water is now being used at the Melamchi subbasin level, and about 80 percent of the available water flows out of the basin (flowing downstream) as river runoff. Of course, from November to May this situation is different.

In this context, the planned diversion of 1.97 m^3/sec of water out of the Melamchi subbasin by the Melamchi water project minimal, which accounts for only 62 MCM per annum compared to the average annual river runoff of 706 MCM downstream even in the dry year. This is only about 9 percentage of the annual average of the total river outflow from the Melamchi subbasin in the driest year. However, due to the higher seasonal fluctuations of the river runoff in the basin and due to the monsoon-dependent river runoff, the average river flow is drastically reduced during the dry season from January to May, when the water scarcity situation would also mostly felt at the basin. Figure 3.3 also shows that the water availability in the basin during the dry season would reduce sharply after the planned water diversion. Nine months of the year, the monthly river flow in the Melamchi river is substantially higher than in the planned water diversion. The average river flow in Melamchi is more than 25 m^3/sec during the peak monsoonal month. However, the river flow sharply reduces from January to May, with an average flow of 4 to 5 m^3/sec. This is also the time when the water scarcity is mostly felt in the basin.

The most affected stretch of the Melamchi river is only 1–2 km immediately downstream of the project intake site. Otherwise, the contribution from the small tributaries downstream should be sufficient to cover any stress caused by the proposed water diversion by the Melamchi project. In spite of the annually sufficient utilizable river flow at the basin (downstream), the water scarcity problems could be localized around the project intake site, especially during the 2 to 3 months (February to May) in a year. The spatial locations of feeder tributaries could still be a problem for the basin-level planning of water use activities.

Due to the unavailability of the long hydrological time series in the Melamchi river basin, particularly in its upper basin around the project intake construction site, a simulated water balances study was done in this study downstream of the Melamchi river confluence with the Indrawati river. Considering the nature and scale of the project, we recommend another detailed water accounting study at the Melamchi project intake site. Findings from such a detailed accounting study will clarify some of the existing doubts and skepticism associated the Melamchi project, particularly the present confusion in the water availability in the Melamchi river downstream of the project.

4. Melamchi Water Transfer Project

The Melamchi Water Supply Project (MWSP) is designed to transfer water from the Upper Mountain range to meet the urban water needs of the Kathmandu valley. This kind water transfer for commercial use is the first of its kind in Nepal and, therefore, this project has large-scale implications for future water development projects in Nepal, particularly when the urban demand for drinking water is equally growing in other parts of the country. The total project cost is estimated to be US$464 million, spread over 7 years, almost half of the annual budget (GDP) of the Himalayan kingdom. This chapter provides an overview of the MWSP, the interbasin water diversion scheme and local impacts of water transfer along with the local initiatives, NGO involvement and project compensation packages to the local communities.

The current average daily water demand of the Kathmandu valley is about 180 million liters per day (MLD[5]), whereas the Nepal Water Supply Corporation (NWSC), a government-owned agency responsible for supplying drinking water, has a capacity to supply only 120–140 (MLD) in the rainy season, which is equivalent to 100 to 116 liters per capita per day. This is reduced to 80-90 MLD during the dry season (i.e., 66 to 75 liters per capita per day). The water demand[6] in the Kathmandu city is projected to increase to 510 MLD in 2018 (MWSB 2000). Considering all these factors, there is an urgency to identify a suitable alternative source of water diversion for a continuous supply of drinking water to the city.

After studying several options, the Government of Nepal (HMG/N) decided to transfer water from the nearby Melamchi river basin to the Kathmandu valley. Details of the Melamchi Water Supply Project are summarized in table 4.1. The first stage of the project is designed to divert 170 MLD (1.97 m^3/sec) of water from the Melamchi river to the Kathmandu city through a 26.5-km long tunnel. In the second and third stages there is a proposal to divert an additional 170 MLD of water by diverting it from Yangri and Larke tributaries of the Indrawati river, as per the water demands of the Kathmandu city in the coming days. The Melamchi water project is expected to meet the long-term (more than 30 years) water demand of the Kathmandu city.

The Melamchi water transfer project is a complicated project plan in Nepal, which involves the construction of a 26.5-km long tunnel in the upper mountain region. About 30 percent of the total project financing is committed by multilateral and bilateral donors as a grant funding, about 45 percent by the World Bank and the Asian Development Bank as a loan, and the remaining 25 percent financed by the Government of Nepal (table 4.1). There is a strict provision for the involvement of the private sectors during the construction phase as well as in management of the water supply system in the Kathmandu city, through privatization of the government-owned Nepal Water Supply Corporation. There were also some preconditions of the donor financing on the project. By involving the private sectors in the water supply task in the Kathmandu city, the Melamchi project is planned almost as a full cost-recovery type of infrastructure project in Nepal, which is an unprecedented practice in the country.

[5] This is based on the water needs of 150 liters per capita per day in the city. 1 million liter per day (MLD) = 0.01157 Cumecs.

[6] Based on the Kathmandu population of 1.2 million, which is growing at the rate of 3.3 percent per year.

Table 4.1. Salient features of the Melamchi IWT project.

S N	Features	Unit	Description
1	Project name		Melamchi Water Supply Project (MWSP)
2	Executing agency		Govt. of Nepal, Ministry of Physical Planning and Works Melamchi Water Supply Development Board (MWSDB)
3	Project duration	Years	6 (July 2001 to July 2006)
4	Estimated cost	US$	464 million
5	IRR	%	13.5
6	Financiers/Donors	No. 9	Asian Development Bank, US$120 million World Bank, US$80 million Other bilateral donors, US$146 million Government of Nepal, US$118 million
7	Source of water	No. 3	Stage I: Melamchi river (perennial) in HELAMBU VDC of Sindupalchowk district located 40 km northeast of Kathmandu Stages II and III: Yangri and Larke (tributaries of the Indrawati)
8	Major components of the project	No. 5	Melamchi Diversion Scheme (MDS): Included access road and tunnel adit, a diversion weir dam 5–7 m high, control system and sediment exclusion and 26.5-km long tunnel running from Ribarma to Mahankal, Sundarijal VDC in Kathmandu. Water Treatment Plant (WTP): Conventional gravity water treatment plant will treat the water for WHO drinking water standard through the process of chemical flocculation, sedimentation, filtration and chlorination. The plant will be located at Sundarijal VDC, on the outskirts of the Kathmandu city. Bulk Distribution System (BDS): Treated water will be conveyed by a network of peripheral distribution system of ductile iron pipes each with a diameter of 300–1,400 mm to the reservoirs built at high locations. Distribution Network Improvement (DNI): Distribution to the consumers by rehabilitated and extended network ensuring quality and equitable distribution, and reduction of leakage and wastage.

The Melamchi water project was first envisaged at the higher political and administrative level in the country considering the water scarcity of the Kathmandu city. The supply of adequate drinking water to Kathmandu has been a major political agenda in Nepali politics for a long time, at least a major political issue for the past more than two decades. In fact, this has been a dream project of each successive government, or political parties in Nepal for the last several years. Likewise, negotiation with the prospective donors for funding and coordinating the local stakeholders for the project compensation package was the major task for which high-level political (or government) commitment was required to smooth materializing the project. Such a high-level governmental commitment also facilitated the resolving of local-level disputes at the project implementation site and reallocation and settlement programs, providing compensation packages, etc. Considering the nature, size and scale of the project in the Nepalese economy, the project implementation could not have materialized without strong political commitment, as it involves a huge investment (nearly half a billion US$) and several institutional reforms in Nepal.

Considering the nature and scale of the water diversion project, it can be said that it has brought several other institutional changes in Nepal, particularly in the infrastructural development and the related scale of project-financing sectors. The experience gained during planning and implementation of the Melamchi project and inclusion of wider

stakeholders in the project decisions are solid foundations upon which the future mega-scale water project planning in Nepal can be built. Likewise, the government's experience in negotiating with several multilateral and bilateral donors together in this project, which lasted more than a decade, could be a valuable information base, and a valuable experience for any future large-scale water resources project planning and development in Nepal.

4.1 Hydrological Consequence of the Melamchi Project

The annual average flow of the Melamchi river at the intake is 933 MLD (10.79 m^3/sec) and the average discharge in the dry season (March/April) is 256 MLD (2.96 m^3/sec). Comparison of average monthly flows at the MDS intake, collected from different sources, is presented in figure 4.1. However, there is no authentic water balance study done at the project intake site; all the previous studies on water availability in the river are based on some sort of guesstimation or on simulation results. Considering the importance of this fact, the detailed water balance in and around the project intake site is an important step to plan for any of the project-related environmental mitigation measures. The structure of environmental mitigation as well as compensation measures should be actually targeted, based on the level of adverse effects of the water stress in the basin caused by diversion of water.

Figure 4.1. Average monthly river flows and the proposed water diversion plan (m^3/s).

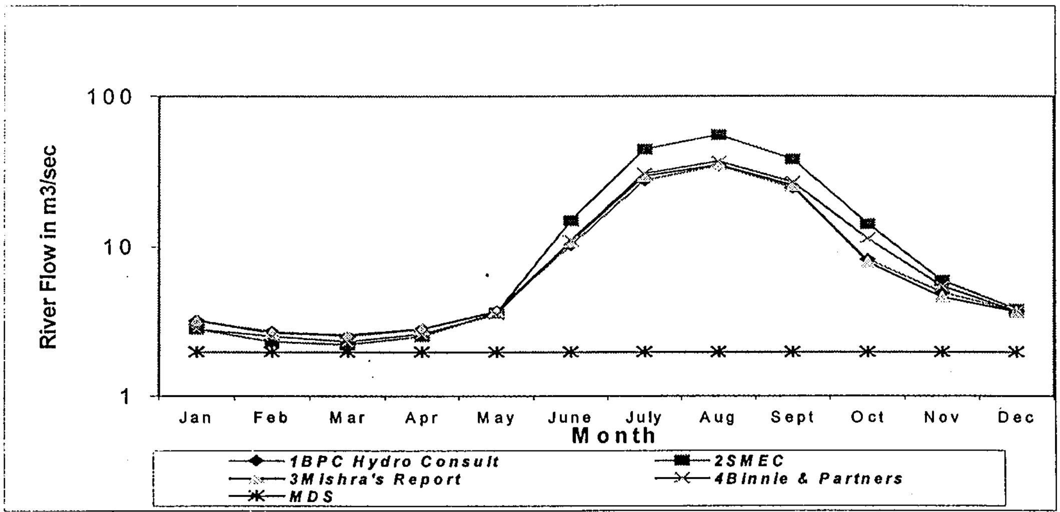


Figure 4.1 indicates that March is the month associated with minimum flow in the river basin, also reported in figure 3.3 in the earlier section. According to the Melamchi project authority, the water diversion project is designed to release at least 0.4 m^3/s of water as the minimum environment flow to maintain the environmental and aquatic ecosystem in the river. The minimum flow of water will also be released even during the dry season (HMGN/MWSDB/IUCN 2000). The above graph on monthly river flow also indicates this fact. However, MWSP has not well informed the local stakeholders about this minimum environmental flow, which will be available in the river even during the

dry months. According to the project authority, this level of minimum flow is adequate for the survival of aquatic life and for maintaining the ecosystem in the river basin. This indicates that the project has given some consideration to the environmental aspect despite the lack of local consultation at the initial stage of the project planning.

The above figure suggests that the water availability in the Melamchi river basin from February to May could be a little problematic, if future water use activities are not planned well. Despite the fact that, on average, there is plenty of water available in the basin, river flows occur mostly during a few monsoonal months. The adverse effects of this water stress would however be mostly confined to within a 1–2 km stretch immediately downstream of the project intake site. Then there are other tributaries that join the Melamchi River, compensating for the planned diversion of water by the project. Due to the lack of extensive long time-series reporting and water balance study around the project intake site, there are several uncertainties on the future water balance situation in the river basins. Considering the scale of the project, there is a need to have a detailed water flow measuring at and around the project intake site.

4.2 Local Impacts of the Melamchi Water Supply Project

Considering the nature and scale of the water diversion from the basin and the level of physical construction works, it is likely that the project would produce both positive and negative impacts in the basin. Positive impacts could be on employment generation and increased effective demand in the rural economy, whereas the project-related negative effects could be mostly in environmental aspects. Some of the Melamchi project-related impacts are summarized below.

Environmental Impacts and Mitigation Measures

The Langtang National Park and the Helambu are famous eco-tourism trekking routes, and are located in the upper water catchment area of the Melamchi river basin. Several of the EIA studies of the project and detailed feasibility studies conducted in the past have not reported any major project-related adverse or irreversible environmental impacts in tourism, and in the basin in general. Some of the small-scale environmental damage could be potentially mitigated with a little careful design of the project-compensation and project-mitigation package.

Cutting of hillsides, altering of sides and blasting the hillsides will have some adverse impacts on the local environment, particularly during construction of the project intake access road from the Arniko highway to the Melamchi Pulbazaar and Timbu (as shown in appendix figure1). Landslide and deforestation in the project construction areas may be increased more than at the natural pace; however, this could be only confined to the construction period, and with careful planning this damage can be mitigated. The rocks extracted from the tunnel construction work will be used locally as construction material, for road and filling tracks, fencing, and building house foundations, and these rocks will be freely available to local community.

There is a problem of disposing of stones, mud and sand that come out of the tunnel adit and its outlet portal during construction. The dumping of waste material will be mainly rock wastes and is calculated to be 460,000 m^3 (IUCN, 1999). Another area of

concern is the possible damage to the surrounding houses and other local constructions due to the blasting and disturbance to the local area.

However, the main access roads to the community will also improve market access to the local community along the Melamchi river, with more than 2,000 households benefiting by getting road access facilities because of the project. Likewise, the local community will also benefit from the rural electrification in the project area with the extension of a 33 KV transmission line brought for the construction work. In the past, several EIA studies have been conducted for the project, including a reputed international NGO like IUCN/Nepal (Nippon Koei, 2000; IUCN, 1999). All of these EIA studies have ranked this Melamchi project over the other available alternate water supply projects to Kathmandu. The Melamchi project will produce the least social and environmental impacts in the basin, which can be mitigated.

Environmental Mitigating Measures

The Melamchi project has planned to leave a minimum flow of 0.4 m^3/sec of water downstream of Melamchi, as minimum environmental flow, to minimize the potential damage to the freshwater ecosystem in the Melamchi river. In addition, there will be other small tributaries joining the Melamchi within 2 km downstream of the project intake site and, therefore, the environmental stress will also be confined to this stretch.

The MWSP has also proposed various measures to mitigate the negative effects of the project construction work in the local environment. There is a requirement to always keep a geologist at the construction sites to monitor and minimize the potential landslides during the blasting and construction work of the project. There is also provision for training of the construction workers in the safe handling of explosives. Deforestation caused during the construction period is compensated for through adequate afforestation activities by the Melamchi project. This will be done in consultation and cooperation with the Department of Forests and existing community forestry groups in the Melamchi valley. There is mandatory provision for the project contractors to dispose of all the debris only at specific locations so that the sediment load due to runoff in the river would be minimized. This is required to protect not only the water quality in the region, but also to have minimum adverse impacts on the aquatic life in the tributaries as well as in the Melamchi river basin.

Socioeconomic Impacts

The Indrawati basin, including the Melamchi subbasin, is a surplus basin. However, the water stress in the dry season, from February to May, could be a little worsened at the immediate 2-km stretch downstream of the project intake site, before the confluence of two small tributaries with the river (as shown in figure 6.1). There are no major water uses within this 2-km stretch of the Melamchi river, mainly due to the rugged mountains and inaccessible places surrounded by the high hill.

However, due to inadequate stakeholder consultations at the project planning stage, the information, related to project activities and the scale of its work activities, water availability in the river after the planned diversion, project compensation packages, etc., is not available to the local community (local stakeholders). This inadequate stakeholder

consultation in the past has caused some level of confusion about the project impacts in the past; however, the local consultation process has been speeded up in the recent past. This was largely due to the complaints from the local pressure groups and may be due to the donors' stringent requirements for local consultation for financing project.

There is a fear that after the planned diversion of water out of the basin, some of the minor water uses like ghatta, or water mills may have to be completely closed down due to inadequate water availability in the river. The fear is particularly for the displacement of ghatta owners from their present locations. These ghatta owners will also be the members in the community getting the least benefits from the project compensation package, which will be spent mostly for local public goods and infrastructures. These minority members will be already displaced from the communities by the time such infrastructure facilities are developed in the community. Therefore, provision of a targeted and direct compensation package to the project-affected communities may be a better option for the welfare of these minority communities that are likely to be displaced from the community.

The tenant farmers in the basin have been renting land for several generations, from the time when there was no irrigation facility from the Melamchi river. The main crop, paddy, is just enough to pay the land rent to the landowners, whereas the winter and spring season crops are kept by the tenants as a return for their labor and efforts on the farming land. Access to the irrigation systems allowed the community to harvest three crops a year. These tenant farmers fear that wheat production (dry season crop) might be adversely affected in the basin due to water diversion out of the basin. This could adversely affect the local household income, since winter and spring crops are the main sources of income for the tenant farmers. However, the tenants adversely affected are few in number and the project can compensate them.

4.3 Melamchi Project Implementation and Local Involvement

Local-level stakeholder consultations by the project authority or from the concerned central-level water authority were minimal during the early phase of project planning, and this was also one of the reasons for the widespread skepticism by the community about the project. It was reported that for the first time the local stakeholders were informed formally about the launching of the Melamchi project only in 1998 in a Public Hearing Program (PHP) held at the Bhumeshwori High School (Kiul) and at the Timbu bazaar, close to the project intake site. The governmental officials then assured the local community of providing enough water to the downstream stretch of the Melamchi Diversion Scheme to fulfill the water demand of the local communities. They also assured the construction of one 15-bed hospital, a higher secondary school and a metalled road from Lamidada to Timbu, thus providing direct access to the Katmandu city, provision of employment opportunity to the local community in the project and protection of the local environment of the Melamchi valley. There is also provision for giving priority to local communities for the project construction works.

Recently, several NGO coordination workshops were organized by the Melamchi project authority with the concerned local NGOs and user groups to identify issues and assess possible areas of their involvement in the project. The NGO Participation Plan (NGOPP) was one of the outcomes of the consultation meetings. The Melamchi project

has assigned some of the local NGOs as facilitators for implementation of various development and social upliftment activities at the project area. The experience gained in the involvement of the NGOs and working together with the local NGOs by the government agencies from the project will be very useful for commissioning of any future water infrastructure projects in Nepal.

A proactive public relations campaign was recently conducted by MWSP to avoid public criticism, to highlight the project profile and to address some of the public concerns to avoid negative feelings, which could potentially jeopardize project implementation. Realizing the need for a mechanism to bridge the gap between local stakeholders and the MWSP, recently the project hired a communication consultancy firm to develop public relations with the local stakeholders. Hence, the project authorities are now trying to reach the local communities and to avoid the public criticisms. Involvement of an international NGO like the UNDP in the project implementation phase, as practiced in the recent past, may improve the transparency of the project operations in the future, particularly implementing the project compensation project activities in the communities.

4.4 Project Compensation Package

Unlike other infrastructural projects in Nepal, the process of local consultations has been recently increased in the case of the Melamchi project and the project implementation authority has developed a compensation package of programs for the river basin (donor basin), as a mitigation measure for social and environmental impacts of the project.

Some of the major project compensation packages include land acquisition, resettlement of displaced communities and provision of infrastructure in the local community affected by the project. Permanent land acquisition is expected for the main access roads, project construction site in the Melamchi valley, certain portions along the tunnel construction sites, a water treatment plant in the Kathmandu valley, and pipeline route and sewerage system improvements also in the Kathmandu vicinity. It is estimated that about 160 hectares of land will be affected in the main project sites, and 246 households will be likely affected either partially or entirely, including 25 households that will be permanently displaced. The project compensation is expected to be able to mitigate these negative impacts in the local community.

In the absence of any formal rules and regulations for a bulk water-transfer project in Nepal, it is the central government agency that has to decide how to compensate for the donor communities for any potential harm in the process of water transfer. The concerned central government authority (Ministry of Physical Planning and Housing) has got a project compensation plan to spend about US$18.5 million for the general welfare improvement activities in the communities as a compensation package to mitigate some of the environmental, social and economic adverse effects imposed by the project. Considering the current development stage and socioeconomic activities there, this level of compensation package represents a considerable sum in the donor communities. Out of **the total compensation package of US$18.33, about US$15 million is allocated for the Resettlement Action Plan (RAP) for a hospital, a road, and school services in the local communities. The remaining US$3.5 million is allocated for Social Upliftment Programs (SUPs) in the local communities (poverty reduction and equity- related projects). The**

Melamchi water transfer project has also got a plan to provide rehabilitation assistance for the irrigation canals that would be damaged during the construction of the access road.

The Melamchi project compensation package includes:

- Improved road access to Kathmandu and within the Melamchi valley
- Increased income through the expanded market infrastructure and the upgraded local skills
- Reduced workload for women and improved access to education in the communities
- Improved basic health and nutrition, especially for women and children

Based on an analysis of the ongoing project activities and involvement of local NGOs, even international agencies like the UNDP for implementing some of the project-related mitigating activities, it is expected that the local community as a whole may get a fair share out of the total compensation package. However, intra-community distribution of the benefits from the project compensation package is not targeted to the actual project's affected sector. Major portions of the mitigation expenditures are for the provision of public goods like the construction of schools, roads and hospital buildings. The benefits out of this local infrastructure are mostly realized by the households permanently residing in the community, but not much by the displaced and project-rehabilitated people (households) directly affected by the project. Since these would be the project-displaced community they might have already migrated from the community by the time these local infrastructures are built. Therefore, with a little more targeting of the project compensation, especially for the affected communities immediately downstream of the project intake site, particularly the minority water users like ghatta owners, there will be more equitable distribution of the project compensation relief, and improvement of the basin community's social welfare.

4.5 Project Implementation and NGO Involvement

To address some of the environmental and social issues, the Melamchi Water Supply Development Board (MWSDB), the governmental authority charged with the implementation of the project, has established a separate resettlement and social development division. The project authority has recently intensified its communication with the local community when local political leaders and communities raised voice against the negative effects of the water diversion scheme, and started demanding for the economic compensation packages for the donor basin. The NGOs and other interest groups formed at the local level also started to exert pressure on the board to address some of these local issues of project construction, and so on. Despite some uncertainty in project financing, and other local concerns, etc., the project work was started in the recent past. The direct participation of the local people on the project was elicited through the formation of a Local Consultative Group at the Melamchi valley consisting of a 15-member committee, representatives of line agencies, a high-school headmaster, social mobilizers (women) and project field officers in the subbasin.

There is a plan to mobilize NGOs to assist local government agencies in implementing the community-based project compensation package. The Social Upliftment Program (SUP) will take a participatory approach through direct participation of beneficiaries and utilize the institutional structure of the Local Governance Program, as this will ensure ownership and sustainability of the projects. Likewise, capacity building for DDCs and VDCs will also be conducted through the program. The local community and the locally elected members of the community have opined that the SUP and Resettlement Action Plan (RAP) activities should also be assisted by additional royalties paid by the Kathmandu valley residents, as a drinking water fee, during the post-construction stage. Given the institutional structure of the water transfer scheme, it is less likely that this local demand will be fulfilled.

Unlike the RAP, which focuses on the construction of public utilities like a school, a road and a hospital, compensation under SUP activities is targeted more towards the project-affected communities. Those households that would lose their means of livelihoods and/or will be displaced by the project activities will receive direct compensation from the project. It is, however, not clear yet whether the SUP activities will also be continued after commissioning of the project. One of the other demands of the local people was to levy an additional 5 percent tax for the Kathmandu water supply with the proviso that the additional revenue from user fees in the Katmandu city should be spent for local development activities in the Melamchi river basin. However, the project officials and the government central authority have not yet committed anything for such a revenue- sharing mechanism.

In term of NGO involvement, the Melamchi project seems to be an entirely different type of infrastructural project compared to other development projects in Nepal, with the involvement of several local bodies and local NGOs even during the project planning and construction stages. Nearly US$18.5 million will be spent for the local communities (donor basin) under the project compensation and rehabilitation package. This level of project compensation was not seen in any other infrastructural projects in Nepal in the recent past. Moreover, it is not clear yet whether existing institutions and the proposed institutional arrangement would be able to handle all these project-compensation and revenue-sharing plans, and whether the existing institutions would be able to cope with the changes brought about by the interbasin transfer project in water resources management at the local level.

5. Water Institutions in the Basin

Both formal and informal water institutions are functioning in the Indrawati basin for managing water uses. The informal institutions are effectively working at the local community level while the role of formal water institutions, i.e., the government institutions, is limited to the central- and district-level decisions on water use. The role of the formal institutions on water management activities at the local level is limited to a great extent, for example, providing financial and technical support for the rehabilitation of irrigation systems, construction of drinking-water schemes, establishment of micro-hydro, and so on. The nature and type of water institutions, institutional arrangements,

and their functions in water management activities in the Indrawati basin are discussed in this chapter.

5.1 Formal Institutions

Central-Level Institutions

At present, two ministries, the Ministry of Water Resources and the Ministry of Housing and Physical Planning, are responsible for water-resources development in Nepal. The District Irrigation Office (DIO) and the District Water Supply and Sanitation Office represent the two ministries at the district level, respectively. The DIO is responsible for new development and/or rehabilitation of irrigation systems, while the District Water Supply Office is responsible for the provision of drinking water and sanitation-related activities in the district. In addition, the Ministry of Water Resources is directly involved in granting licenses to the private sector for the development of large-scale water development projects like hydropower (Indrawati hydropower). The activities of the water-sector government institutions at the district are mostly based on the sectoral approach, and they lack coordination within various sectoral agencies in the district.

The Nepal Government formed the Melamchi Water Supply Board to look after the water transfer out of the Melamchi river to the Kathmandu city, which is directly responsible for the overall supervision and implementation of the Melamchi Water Supply Project (MWSP). The Water and Energy Commission Secretariat (WECS), a central-level water policy formulation and study center of His Majesty's Government of Nepal (HMG/N), is also involved in various policy studies in the basin in relation to developing an integrated water resources management plan for the basin.

District-Level Water Institutions

District Water Resources Committee (DWRC)
The Water Resource Act of 1992 created DWRC to coordinate all the water-related activities within the district and to avoid potential water-related disputes in the district. The Chief District Officer (CDO), the chief administrative and security officer in the district representing Ministry of Home Affairs, is the Chairman and Local Development Officer, Ministry of Local Development (MLD) and is the ex-officio secretary of the DWRC. It is mostly the water-sector-related government agencies functioning in the district that are represented in the DWRC, but not from the users' sector.

The role of the DWRC at present in the Sindhupalchowk district, where the Melamchi project work is going on, is basically confined to the following areas:

- registration of water user committees for the irrigation systems
- advice and suggest DDC/VDC to resolve the water conflicts as per the water acts, if there are any complaints filed to the committee
- recommend and advice DIO for the construction of the new irrigation systems at the request of the users
- resolve any other water-related disputes between WUAs brought to its notice

Governmental officials dominate the executive committee of the WRC and they are not at all represented by farmers (irrigation user associations) and other local water user associations in the district. In reality, it was found that the DWRC of the Sindhupalchowk district had not met for more than a year, almost the same sort of situation that existed in other districts. This was primarily due to the frequent changes of the Chief District Officer (CDO), who is also the ex-officio chairman of the DWRC. Besides, the job of the CDO is usually preoccupied with administration and maintaining security in the district. The water issues are at a low priority level to the CDO compared to other administrative issues in the district.

During the field study, it was noticed that there was, however, an increasing concern from different sectors, even within the local government organizations, to modify the structure of the DWRC and accommodate more local stakeholders like the WUAs. It was found that the DDC was interested in altering the function of the DWRC to be consistent with the Local Governance Act (1998). However, the level of adjustment in functions and jurisdictions of the DWRC and the DDC requires a change in other national legislations and the Water Act (1992).

District Development Committee (DDC)

The DDC is an elected institution in Nepal responsible for the coordination and implementation of all the local development activities within the district, which range from 50 to 100 villages (VDC). Its role in the water sector is increasingly becoming important and it also provides financial subsidy to the water development project in the district. The DDC of Sindhupalchowk in 1999 provided NRs 178,000[7] and NRs 150,000 for micro-hydro installation in *Thangpaldhap* and *Thangpalkot* VDCs, respectively. Nevertheless, the DDC president of Sindhuplchowk opined that the coordination between various agencies in the district for the development of water resources was lacking, since the central government in principle, does not recognize the role of the DDC for the development of water resources in the district.

Conflicting Role of DWRC and DDC

In principle, the DDC does not have any statutory role in the formation and registration of the UC for the irrigation and other water use activities in the district. The District Irrigation Office (DOI) plays a key role in the formation and registration of such irrigation user associations in the district; however, the DDC is more or less directly responsible for water-sector and agricultural development, and the overall development planning in the district. The District President of Sindhupalchowk, where the Melamchi project work is going on, has very critical views on the structure and functioning of the District Water Resources Committee (DWRC) in the district. He criticized the existing Water Act (1992). He thinks there is overrepresentation and dominance of government officials in the DWRC and, therefore, he has recently even pulled out the DDC representative from the DWRC. On the same issue, he has also filed a court case at the Supreme Court challenging the authority of the DWRC with respect to registration of the

[7]US$1.00 = NRs 73 in late 2000.

Users Committee (UC) at the DWRC, which he thinks is against the spirit of the Local Governance Act (1998). The Supreme Court verdict in this case would have much larger implications in the structure and functioning of the DWRC all over the country. This could bring a large-scale institutional change in the functioning of the water sector in Nepal; however, the delays in the court procedure still constitute one of the limitations here.

The DDC President of Sindhupalchowk also thinks that the Chairman of the DWRC should be the DDC President, so that the DDC will have a greater role on the development of water resources in the district. He was also of the opinion that the government should specify private sector contribution to local development and royalty sharing in the district while issuing a water license for new water development projects (like hydropower) in the district. Besides, the local body (like the DDC or VDC) should also be empowered to tax the private-sector development of water resources in their jurisdictions, and the concerned government authority should compensate for any local-level negative impacts caused by the large-scale water resources development projects. In essence, the DDC Chairman thinks that the DDC should be an authoritative decision-making body in Nepal for integrated water resources management and development in the district.

Despite of the sort of confusion and conflicts of interests, the DDC of Sindhupalchowk has been assigned by the Melamchi Project Authority to play an active role in coordinating the activities of the local NGOs, known as the NGO Participation Plan (NGOPP), in the district.

Village-Level Institutions

Village development committee (VDC). The VDC role in the water sector is mostly confined to providing occasional financial support (grant) for the construction of the irrigation systems (FMIS) and investment for the micro-hydro development, construction of an access road, and financing other small- scale infrastructure development projects in the district. For example, the two concerned VDCs in Sindhupalchowk jointly provided NRs 310, 000 for the installation of the micro-hydro in *Thangpaldhap* and *Thangpalkot* VDCs under the governmental annual assistance program to these VDC. The local VDCs also provided small-scale financial and material (polythene pipes, cement, etc.) support for the construction of the drinking water supply of the community. Occasionally, ghatta and water mills are also registered at the VDC level; then the VDC collects a registration fee from these enterprises. The VDC also occasionally involves in resolving some of the water-related disputes, especially between irrigation systems and ghatta and/or water mills. However, the VDC has got a minimal role in the day-to-day management of the water use activities, since its role in the development of the water resources is not yet officially recognized in the existing Water Act (1992).

Moreover, the Melamchi project authority has given responsibility to the concerned VDCs for coordinating and monitoring the activities implemented by the NGOs under the MWSP (the Melamchi Water Supply Project)[8] in their respective jurisdictions. These activities involve project rehabilitation and resettlement, and other project compensation-related projects. Unlike other water infrastructure projects in Nepal, the MWSP has given

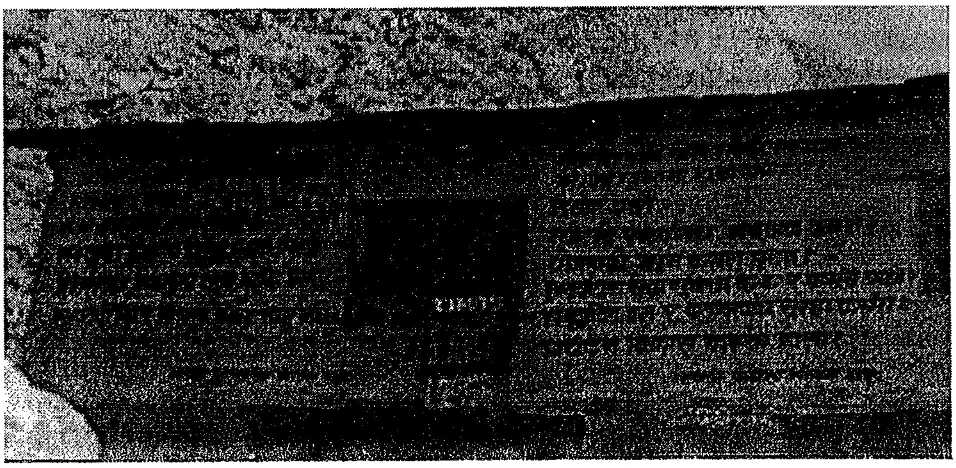
[8]A detailed description of the Melamchi Water Supply Project was provided in chapter 4.

due consideration for the involvement of locally elected institutions in implementing the project activities in the basin communities.

NGOs. Altogether, 65 NGOs have been officially registered in the district, many of which are directly concerned with the Melamchi project. The sudden increase in the number of NGOs in the project area was mainly due to their expectation for involvement in the Melamchi project activities. The emergence of so many NGOs and local pressure groups in the Melamchi project area is one of the important developments and marked institutional changes seen in the project area, mainly brought about by the Melamchi project. However, not all of these NGOs are equally effective in looking after the interest of the local communities.

In addition, most of these NGOs have been focusing mainly on their activities in implementation of economic packages under the project compensation programs, rather than looking at the needs of the local community, and so on. Nevertheless, these NGOs, particularly in the recent past, have played an important role in raising awareness and concern among local people about the Melamchi project and its likely impact on the livelihood of the local communities. The nature of the awareness campaign and pasting wall posters carried out by the local NGOs in the local communities are as shown in figure 5.1. Some of the points raised in figure 5.1 are about alerting the local community to pay special attention to some of the project's likely impacts in the community, for example, what will be the project impacts on the community cultural systems and traditional values?; how can the local community be more involved in the project activities?; who will be implementing the project in the community?; what will be the project's impacts on community forestry, local environment and community tourism sector, etc.?

Figure 5.1. Public awareness and pasting wall posters about the project by local NGOs.



WUAs. There is a certain advantage of creating formal organizations to efficiently mobilize resources and to protect the legal right of the resource users, particularly for managing the common property resources like irrigation services. Some of the irrigation systems in the basin, which were rehabilitated by the IIMI/WECS project earlier in late

eighties had a users' committee (UC) formed during the time of rehabilitation, except for some informal mechanisms operating for regular O&M of the systems. These WUAs were formally registered then, but they are not functioning actively as they were during the construction period. Most of these WUAs were actively functional during the time of construction and rehabilitation phase and whenever they had to obtain resources from outside, a strong stimulus for organizing the collective action. Occasionally, the local community members, even without a formal organizational structure, are able to mobilize the needed collective actions and get access to the external funding for small-scale repair and maintenance work, for example, traditional operation of FMIS. Such external assistance is specially asked for new construction, or rehabilitation of physical structures of water resources. For example, the Gorebesi kulo has mobilized labor contribution equivalent to NRs 122,000 for rehabilitation of the irrigation system. The UC members also deposited the up-front cash fund of NRs 65,000 for the system rehabilitation.

There is a general trend in such a WUA that one of the major stimulations for the initiation of the collective action in the community is that the expected additional benefits generated out of those efforts should be higher than the cost of the collective action. It was noticed that some members of the UC became active only when they had to mobilize the external resources from the VDC, international NGOs, and governmental agencies for construction or O&M of irrigation systems.

It seems that the existence of formal organizations is not a prerequisite for initiating such small-scale activities and for collective action in the communities. However, it is better to have in place a formal organization to mobilize external resources and to protect the legal rights of the users in a larger water resources project. Formal registration of a UC is one of the conditions often set for providing financial support and construction-material support by most of the intervening agencies. This is also important to legally protect the water rights of each member in the community.

This type of organizational behavior is, however, consistent with the Common Property Resource (CPR) management and collective action theories (North 1990; Ostrom 1993). The marginal benefits out of the project rehabilitation work are substantially higher than the day-to-day managing of the canal later on. The collective action is not a cost-free adventure; some strongly felt impetus is required to overcome the transaction costs of community actions and coming together for negotiation costs.

The local community also mobilizes DDC and VDC resources for the development of micro-hydro in the area for which the two tiers of formal water UC formed for micro-hydro projects, under the Rural Energy Development Program (REDP) of UNDP. Each of the settlements has one committee to coordinate the activities of the users at the community level, and these committees sent one representative each to form a main committee at a higher tier. The primary task of the main committee is to ensure proper functioning of the micro-hydro by mobilizing resources through the collection of a service use fee, timely O&M of the system, and to maintain linkage with the outside institutions. At present, REDP is also providing necessary technical and managerial support to the UC. Two such water UCs have been recently formed in the study area of **the Indrawati basin, but it is too early to judge their performance. It would be interesting to look at the performance of these micro-hydro committees in future vis-à-vis the performance of the committees formed for the irrigation management (FMIS).**

5.2 Informal Institutions

Basically, informal institutions, i.e., local traditions and customs, set norms for almost all water allocation practices in the basin. The water allocation among different sectors is based on the mutual agreements and customary laws. No strict water-allocation-related formal rules have yet been developed at the local level, perhaps due to the relative abundance of the water resources in the basin. The basin is still at the lower stage of economic development. The available water in the Melamchi, Handi, and Mahadev khola, major tributaries of the Indrawati river basin systems, is mostly shared among the irrigation systems: the water-turbine-operated mills, ghatta (traditional water mills) and the micro-hydro. The water mills are usually privately owned, whereas the irrigation systems and the micro-hydro are usually community-owned resources, and they are managed as Common Property Resources (CPR).

Informal institutions are usually hidden deep in the social customs and cultural traditions, so it is difficult to isolate and pinpoint all of these informal norms precisely working in one sector of resources use. Rather, they are all working in web-like structures, one affecting the other and the last affected, in turn, being affected by the other community practices. Among these informal water rules and institutions, the water allocation mechanism between farmers (usually upstream) and the water mill (downstream) and/or ghatta is particularly interesting and fascinating in the case of the Indrawati river basin.

Mill owners, or the micro-hydro committee, does the construction and operation and seasonal maintenance of irrigation canal. Water in the canal is shared with the farmers free of costs. The irrigation is provided to the closed by field plots, as a secondary benefit out of the water mill. Farmers do not contribute for the O& M of the field channel, but they are getting the irrigation benefits mainly for sharing their prior water rights, and for providing the land for the field channel to deliver water up to water mill at the downstream. From outside, it looks as an efficient system and an undue burden to the mill owners, but it is the social-cost minimizing norm, which will minimize the transaction costs of the collective action of the community. The mill owners have a larger stake in the operation of the business, so they perform more timely maintenance of the field channel than the smallholder farmers each with less than half or quarter hectare of landholding.

The mill owners and irrigators have adapted an effective O&M system for the canal networks. Informal water rights and enforcement mechanisms have evolved to match the local situation. Locally derived O&M procedures exist and are fairly well adapted to the rugged mountains, which are prone to frequent landslides. The property stakes and the expected benefits out of the timely maintenance of the canal are different between farmers and the mill owners. In case of multiple water use, the ownership is shared between the owners of various uses and a written agreement is made to guarantee the rights of users.

The institutionalization of the water allocation arrangements for various uses, which has provided a kind of water rights to the present users, has not encouraged them enough to form a formal organization. At present, the users' interests are represented collectively through the group, which relatively becomes active whenever there is a need to protect the group's interest in protecting the water rights and whenever there is a need for

collective action. This was evidenced from the arrangement made by the community in night patrolling the canal to ensure the allocation of the water equally to all members, and the initiative taken in the construction of a new irrigation system. Besides, the user groups have been able to negotiate and develop an appropriate mechanism for water allocation with other water use activities. Likewise, the farmers have informally negotiated with the private mill owners and with the micro-hydro committee for the O&M of the canal in exchange for sharing the water rights. Mill owners and micro-hydro committees are responsible for the O&M of the canal up to their water use activities.

The customary law practiced in the basin gives first priority of water uses to irrigation service over various other activities. This could be primarily due to agricultural-based development activity in the basin. Besides, activities of all other sectors, including the water mill, and ghatta operations, directly depend upon the success of the agricultural crops grown in the community. The informal water allocation rules are institutionalized through mutual agreement and informal negotiations among the various water use activities. They are also known as customary law based on cultural tradition.

The consent from the prior water users is necessary before developing any new water use activity in the area. Water allocation rules are not formalized in the basin in the form of a constitution of WUAs, as seen in other parts of Nepal. The water rights are not required in the Indrawati basin, perhaps due to the absence of any serious water disputes, except in isolated cases. A formal WUA is not a common practice here, except for the irrigation system, which usually receives external assistance, and the establishment of such formal WUAs is sometimes a prerequisite for receiving any form of external assistance from the government or international NGOs.

In summary, it can be said that the institutional framework has evolved in the river basin ingeniously, to manage local water supplies, but it is not sure whether institutions evolved for managing local-level, small-scale problems can also be able to cope with the external shocks brought about by such mega-scale water development projects like the Melamchi water diversion project. Fortunately, there is ample water available in the river except in a few dry months that help to "lubricate" conflicts. Along the Indrawati river system, there is little need for upstream-downstream coordination because of the sufficient amount of water in the river, but there have been cases where local institutions have evolved to resolve such issues in the case of small tributaries, where the water flow substantially reduces during the dry season. The question then is whether such informal institutions will be adequate to resolve the issue on bulk water transfer outside of the basin.

6. Water Rights, Allocations and Conflict Resolution

This chapter summarizes the water use activities, water allocation practices and water-related disputes in the Indrawati basin areas. The discussions here are not directly related to the Melamchi project and its activities, rather, this chapter provides an overview of the water use activities in the local community, an understating of which will provide a reference basis for analyzing the impact related to the Melamchi project. A proper understanding of these issues and the water use practices in the basin will provide a solid foundation for designing the Melamchi project compensation package. Therefore, it is

expected that the information provided here would be highly useful to the project officials and to others for improved management of the water resources in the basin in the framework of IWRM.

In Nepal, the Water Resources Act of 1992, and its bylaws in 1993, were introduced to regulate the use of water resources in the country. According to the 1992 Water Resource Act, the ownership of all the water resources is vested in the Government of Nepal. A government license is required for the development of the water resources other than for small-scale water resources development on private land, and for individual and collective use for the drinking water and irrigation. The law has also prioritized the use of water, according to which drinking water and irrigation, and agricultural uses (animal husbandry) have received priority over other uses of water in the community. At the same time, the *Muluki Aain* (civil code of Nepal) of 1963 has guaranteed the customary use right and prior appropriation right of water users.

6.1 Major Stakeholders and Water Rights

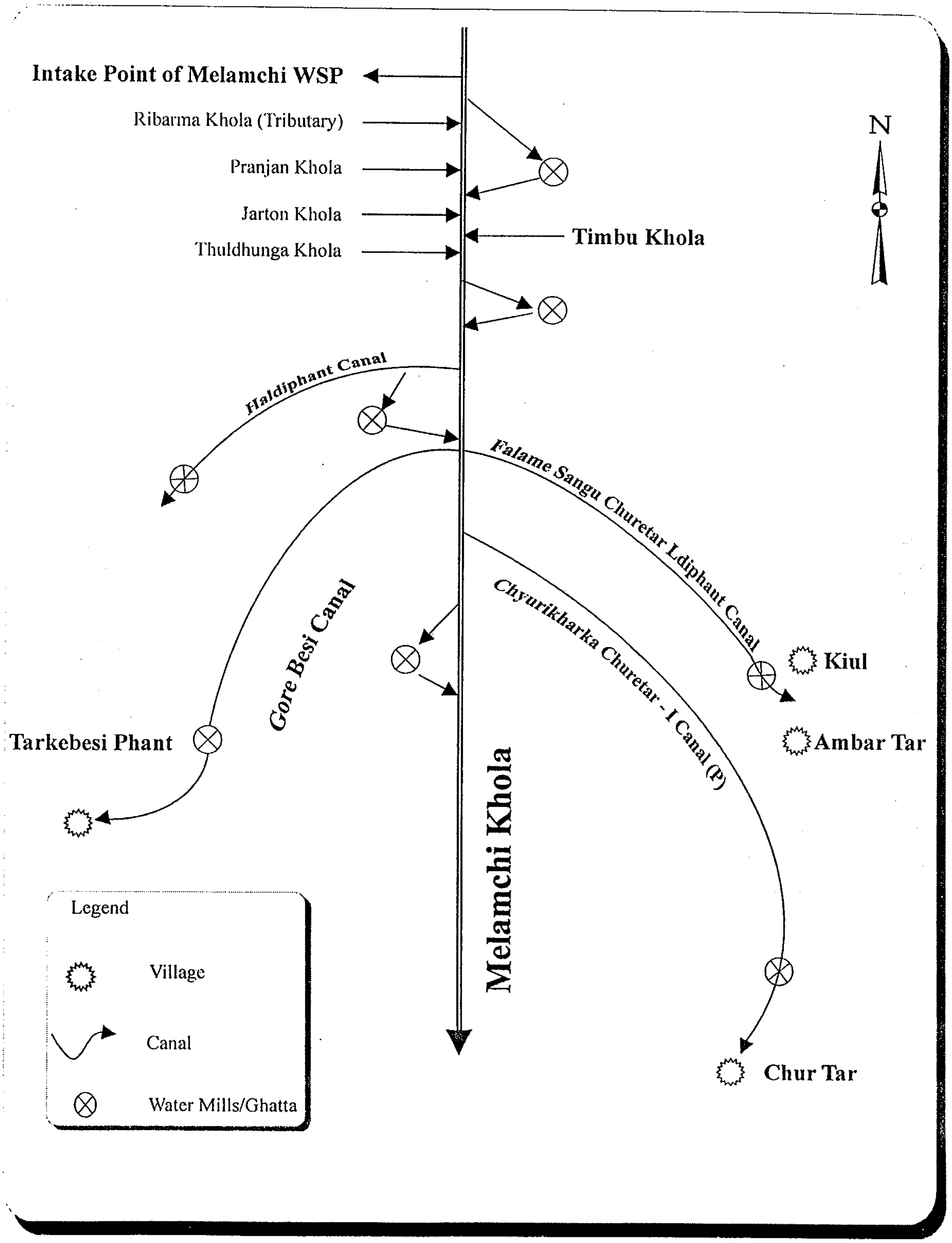
Irrigation users, ghatta owner, water mill owner, and micro-hydro users are the major stakeholders in these three tributaries. The typical water use activities are shown in figure 6.1. The irrigation use association (FMIS and other committees) and the newly established micro-hydro committees are relatively organized stakeholders. The community consultations and stakeholders' participation for service use and cost sharing are the basic features of FMIS. During the recent development of several new water projects in the basin, the roles of these traditional stakeholders are in a changing process. Now, the DDC and VDC are also in the process of becoming a major local-level institutional stakeholder of the water resources.

According to customary law the existing water users have got the first rights to use the water over the newcomers. Hence, any proposed diversion of water from the river basin should not negatively affect the present water use practices, unless they are adequately compensated for. In the absence of adequate information on how much water will be left in the river after diversion, it is not sure whether the customary use right of the present users will be protected. Because of the availability of sufficient water in the basin and the lower stage of economic development there, it is expected that the potential adverse impacts of the water diversion project at the donor basin (Melamchi) will be at a minimum level. However, the situation may be different in the future, depending upon the future development activities in the basin.

After drinking-water needs, irrigation gets priority over other uses, which is followed by ghatta and water mill, or hydropower. Water rights of all sectors are secured in three ways:

- according to customary practice, where first user gets priority (a kind of appropriation rights)
- physical situation—priority to head enders over others, (i.e., riparian rights), and
- registration at VDC, or at DDC, or contribution for the establishment of private enterprises and communal property viz. ghatta, water mill, micro-hydro, etc.

Figure 6.1. Water use practices in the Melamchi WSP intake in the Melamchi river subbasin, Nepal (not to scale).



Some ghatta owners have secured their water rights either by registration at VDC and/or by location at the upstream of the other irrigation systems. However, the irrigation system, even at the downstream, gets priority over other uses during transplantation and flowering stages of paddy. This is logical considering that agriculture is the predominant occupation in the society, and that the community well-being in a year largely depends upon the success of the agricultural production in that year.

The water-turbine-operated mill owner usually gets secured water rights through the consent of users of other activities for taking responsibility for the O&M of the field channel. That is, approval of prior users is important in the community for securing new water rights, or altering the existing water rights.

In many irrigation systems, the water rights of the poor and marginalized groups of farmers are not secured as those of the others. For example, in the *Subedardhap* irrigation system, the hydropower main committee has a dominating role in allocating water among different water uses, viz., irrigation, hydropower, water mills, and ghattas. The majority of the UC members of the micro-hydro community are head-reach farmers and they also belong to the well-off groups of communities. Others have complained that it is often hard to get a decision made in the committee in favor of the poor and marginalized people. Some of the ghattas have even secured water rights by paying an annual fee to the VDC. However, when it comes to allocation of water during the dry season—water-scarcity period—the decision of the farmers (irrigation users) always prevails over the other water users (ghattas). Therefore, inequity in the enforcement of water rights and water allocations is there, despite the fact that some have got formal water rights. This is also due to lack of an equal participatory decision-making process at the local level. The inclusion of the tail-end farmers in the UC in the case of the irrigation system and the arbitration of any dispute by the VDC (local elected body) would potentially reduce such inequity and help ensure protection of water rights of all the users.

6.2 Processes of Inclusion and Exclusion in Water Use Services

The processes of inclusion and exclusion of the users (communities) in water use activities are largely determined by the process of new investment in water resource projects by the government, community, or by the private sector. The negotiation and the compromise reached among the concerned parties affect the process of inclusion or exclusion of certain groups or communities in the use of future water project services. Those who are able to influence the decision-making process are usually included as project beneficiaries and they get benefits from the development of new water use activities. Understanding the needs of various water users and providing an opportunity for their participation in new water use activities are crucial for the inclusion of large number of users, especially the poor and marginal users who are generally excluded from receiving the development-project benefits.

Irrigation

In selected tributaries of the Indrawati basin, rehabilitation of irrigation systems included some new areas as well as new users in their respective command areas. For instance, in the rehabilitation of *Subedardhap Ko kulo*, irrigation systems enable it to expand an additional 60 hectares of rain-fed upland of 40 households in the command area. Likewise, the rehabilitation of *Nayadhara* irrigation brought an additional 30 hectares of land into the command area in the *Thangpalkot* VDC.

Despite increases in the irrigation command area after the rehabilitation of the irrigation systems, some of the households that were interested in joining the irrigation system could not be included due to technical and other factors. For example, in the *Taruki Besi* irrigation rehabilitation project, some farmers were left out of the command area due to the construction of a new intake/canal upstream of the existing temporary intake because of topographical and geographical constraints. The excluded farmers, however, did not protest as the change in the intake site was due to a genuine technical reason. The previous intake site was vulnerable to landslide and erosion.

Micro Hydropower

The poor and marginal households are usually excluded from the service of electricity generated from a privately owned micro-hydropower because of their inability to provide the required financial contribution for its construction. Some of them are not in a position to pay the monthly minimum electricity charge (about NRs 25.00 per month). The case is however, different in the community-owned hydropower projects, where the users have to contribute labor in construction works to get access to the electricity services. There is however a provision to include these households again by charging them twice that of the others, if the concerned community organization permits it to do so. In the case of the electricity from a private owner, it is distributed only to those people who are able to pay the electricity charge, which is a natural way to encourage private operation in the sector. To avoid this economic exclusion, the DDC contribution of the micro-hydro should be targeted to the service provision to those vulnerable households. Besides exclusion related to economic factors no cases were noticed related to social exclusion in the case of the use of micro-hydro service in the studied areas.

Drinking Water

In the selected drinking-water supply projects, some people were excluded from the drinking water facility due to technical problems (such as scattered settlement patterns and costly fixed expenditure for establishment of the facility). For example, eight poor *Tamang* households of the *Nayadhara* drinking-water supply project and two households of *Giri* people of the *Nagi Danda* drinking-water project were excluded from the drinking-water facility due to relatively high cost of separate tapstands for those households because of the scattered nature of the settlement. The inability to bear the high fixed cost was the major reason for their exclusion.

Fishing

Some of the Danuwars and the traditional water mill owners are also involved in fishing activities in the basin, but this is done in their spare time. This is one of the major sources of their cash income. These fishermen opined that they might not have enough fish collection in Melamchi due to reduced river flow after the water is transferred out of the river, and that they might lose one of their major sources of household cash income. There are only a few households downstream of the project that depend on fishing. Hence, it should not be a major economic loss to these communities as a whole, if the selected households are duly compensated for the economic loss. Proper resettlement to these selected households should compensate for the welfare loss caused to them by the project.

Multiple Uses of Water and Exclusion of the Ghatta

Development of new irrigation systems and/or rehabilitation programs of old systems have gradually excluded ghatta owners from their water rights to use water to run the ghatta mostly during the dry season. Several ghatta owners have complained, for example in the *Thangpalko*t VDC that the water rights of Handi *khola* ghatta were encroached by new users without any compensation to them. This type of encroachment on water rights frequently occurs during the dry season, when the river flow is at minimum level and during the paddy planting seasons. The traditional norms of giving priority to the irrigation water use and rotation system introduced for allocation of water between irrigation and ghatta have led to this situation. The farmers (irrigation users) are in a majority and are relatively better-off in the communities; hence they usually set the rules for the water allocations for various sectors, which usually marginalizes the ghattas and other minority water-rights holders in the communities.

Besides, the ghatta owners reported that they are usually not consulted when new water use activities are implemented in the village, and their requirement is not properly addressed even if there is any such village-level consultations (a kind of social exclusion). Hence, the development of new water use activities has negatively affected the prior use right of the ghatta owners, like the new water allocation norms introduced after the construction of the irrigation system in the area. Some of the ghatta owners immediately downstream of the project intake are likely to be affected also from the water diversion. Therefore, the project compensation package should address these issues carefully so that appropriate compensation can be made, targeted to the project-affected communities, and more to the adversely affected households.

6.3 Impact of the Inclusion and Exclusion

The processes of inclusion and exclusion in the irrigation sector bear considerable impact on the livelihoods of local people (households). The newly included farmers in an irrigation system have been able to harvest three crops a year, paddy in the spring and summer, and wheat in the winter. Access to irrigation is entitled for a permanent income, wealth creation, and well-being to the households compared to those excluded from such facilities.

The damage to the canal in *Kiul* VDC by Melamchi- Timbu road, constructed by the MWSP has excluded several households from the irrigation facility, electricity supply and water mill services. Therefore, the lives of the *Ambar Tar Churitar Ko kulo* people have become a little harder now due to the exclusion from the irrigation and mill operation. This is however expected to be temporary until completion of the project construction work. On the other hand, this road has facilitated the people of *Palchowk Beltar Bhattar* villages to export locally produced milk and the crops to the Kathmandu valley market throughout the year. The road infrastructures have given different types of impacts depending upon their locations.

It was noticed that the prior water use rights of the minority community were commonly encroached, when initiating a new water project in the community, and this is due to lack of both formal water rights and an enforcement mechanism on water rights. There is a need to have an adequate benefit-sharing mechanism and provision for compensation to those excluded from the new water service facilities. The exclusion of the poor and marginal groups in the use of hydropower services due to their inability to pay monthly bills could be addressed through additional income-generating activities in the villages. This can also be addressed through DDC-targeted subsidy to the selected group using their labor force as a contribution for the rehabilitation and maintenance of the project. This would enhance their capability to pay for the services as well and will not suppress the private entrepreneurship in the village to further invest in the micro-hydro project or water mill.

Special attention needs to be paid for the water rights of the different sectors to avoid the social exclusion in water uses. The encroachment of the water rights of the minority community members is commonly seen more than that of the majority community (farmers), which is also one of the reasons for the inequity of water uses across the members and sectors. In the irrigation sector, additional funds for construction of the intake structures will resolve most of the water crises in the basin; however the economic scarcity on managing water is problematic. The Indrawati river basin is still an open basin and water availability for irrigation is not a constraint, but the financial resources required for the development of the physical structures and intake construction task are limited. Likewise, careful planning, and inclusion of the tail enders in the UC could ensure protection of their rights to derive benefit from the water uses.

6.4 Water Disputes and Cooperation

The discussions in earlier sections showed that the present water use is at a minimum level in the basin but customary practices and informal arrangements of water allocations are working satisfactorily to resolve any disputes among the users. No serious cases of water disputes have been noticed in the basin, perhaps because it is an open basin. Some of the selected characteristics of the basins in relation to water disputes within a sector, or across the sectors, are as follow:

- **Abundance of water availability in the river basin, since Indrawati is still an open basin.**
- **Almost all the water-turbine mills are located downstream. Therefore, the mill owners spend for the annual O&M of the canal and the farmers get free irrigation services for**

providing access to the land for the construction of field channels for water mills. This level of extra benefits to farmers may be a compensation for sharing their prior water rights with the new water users (water mill) in the community.

- There is a customary practice of maintaining a distance of at least 200 meters between the upstream and downstream intakes along the river. This has helped reduce conflicts between the two irrigation systems (or ghatta, and/or mills intake). A new intake at the upstream should maintain a distance at least 200 meters from the existing intake. The downstream users would not allow a new construction if the upstream user does not follow this practice, unless there is sufficient river flow year-round.[9]

Nevertheless, some water-related disputes occur in the basin community, occasionally when the irrigation users disrupt the water flow to the ghatta and the water mill without informing the owner. This happens especially during the winter and spring when the water flow in the canal is reduced.

Water-Related Disputes between Ghatta and the Farmers

The reported cases of water disputes are between the ghatta and the farmers, and are mainly seen from February to May when the water flow in the river decreases substantially. The irrigation users claim that the ghatta owner does not check the leakages in the field channel, which would otherwise increase the flow adequately to meet the need of both users. Unlike the water disputes in the irrigation use and the water mills, no appropriate mechanism exists for resolving the disputes between the farmers (irrigation users) and the ghatta owners. Because of the large numbers, the farmers usually ensure adequate flow in the canal for their fields even by disrupting the ghatta operation, and closing its operation a few days during acute water-scarce times. The farmers usually also depute someone for patrolling the canal and to guard the intake side to maintain continuous flow of water in the canal during the water-scarce times. The ghatta owner cannot do much due to the large number of the farmers in the community. However, the VDC could intervene in this sector and efficiently resolve some of the disputes. VDC membership is a little more representative of all the community in the area since the electorate provision for VDC gives the suppressed community at least a chance to exercise its voting power in every 5-year rotation.

Conflicts between Irrigation and the Water Mill

Disputes occasionally occur between irrigation users and water mills mostly in small tributaries, and mainly for the spring crop (beginning of May) and in the main season paddy planting season (beginning of July). One of the VDCs in the basin resolved such disputes in the past by proportionately allocating the water between the upstream and downstream users, which is abided by both the upstream and downstream users.

Sometimes, water-related disputes are also seen during paddy harvesting when there is leakage from the canal, mainly due to lack of maintenance of the field canal on time. In

[9]In reality, 200 meters' distance varies by locations, considering the mountain, topography, etc. This distance will avoid the potential conflict among water users in the river areas. But, customary law suggests maintaining the distance, to prevent any potential disputes.

the past, one case had also been filed at the VDC. Occasionally, there are also cases when farmers have disrupted the water flow to the ghatta*s* and water mills. Likewise, the mill owners have got complaints that the irrigation users do not contribute anything—neither labor nor capital costs—for the O&M of the field channel, and farmers even do not share costs for augmenting water in the canal. However, the farmers receive almost a free-rider benefit from the present setup. There was even a serious violent physical fight between one of the mill owners and one of the farmers during the spring crop season of 1999. The case was reported to the VDC and the VDC chief resolved the dispute. The mill owners in the area favor to have a cost-sharing mechanism with the benefiting farmers (irrigation users), specifically for O&M of the field channel. Some of the VDC officials also agree with this proposition; however the farmers (the irrigation users) do not like the idea of contributing to the O&M of the channel since they think they have got the first right for irrigation by providing the land for the field channel. The local water institutions are in the evolving process, and such frequent frictions may ultimately provide an incentive for better local-level institutions in the future and the establishment of some sort of formal water rights or a formal cost-sharing mechanism.

There are some cases of disputes between the irrigation users and the mill owners and in some tributaries of the *Melamchi khola,* for example, the dispute between the *Jageswor kulo* and *Tarshera phant kulo* in Melamch*i* VDC was due to the construction of a new intake at the upstream. The case even went to the District Administration Office and the District Development Committee (DDC). However, the DDC sent the case back to the VDC to resolve it, based on the local situation and the field realities, within the jurisdiction of the VDC.

Resolution Mechanisms for Water Disputes

Until now, the disputes between the irrigation users and the mill owners were usually resolved through dialogue and mutual understanding between the two parties. It is usually the mill owner who puts extra effort to increase the water volume in the field channel, and the mill owner is responsible for all the O&M costs of the canal. In a situation when it is not possible to increase the water in the canal, the mill owner closes the mill for 1-2 hours when irrigation is required. As water gets scarce, this type of customary law, which allocates costs unequally among the water users, norms designed for a plentiful water-available situation, may create further conflicts among the users, unless there is timely evolution of better institutions. Therefore, such occasional disputes between farmers and water mill owners may assist to establish some sort of formal water right negotiation, or a water-sharing mechanism.

The customary practice of maintaining at least a 200-meter distance between the upstream and downstream intakes, to some extent, has helped reduce conflicts between members of the two irrigation systems, and/or other users. Occasionally, the VDCs also intervene to resolve the water-related disputes between the irrigation systems; for example, in one of the tributaries of the Melamchi *khola,* the VDC intervened and forced to use the water, based on proportionate allocation between the upstream and downstream users. The water allocation was proportionate to the landholding in which the *Jageswor kulo* (upstream FMIS) was allocated to use water for 4 days and *Tarshera phant kulo* (downstream FMIS) for 3 days. Both the upstream and downstream irrigation users

agreed to this ruling. This arrangement was only meant for the spring crop (beginning of May) and the planting season (beginning of July), when water scarcity is largely felt. Both the upstream users and the downstream users have abided with the above decision of the VDC.

In relation to the water disputes, the local-level elected institutions (DDC and VDC) lack authority and also technical and managerial capability to effectively plan for water resources development in the district. The DWRC, which could have played a key role in resolving such large-scale water disputes within the district, is almost defunct functionally. Its role is confined to the registration of the WUA, which can even be done at the District Irrigation Office.

With respect to managing the water resources in the principles of IWRM, the local communities are managing the water resources using the century-old informal institutional mechanism. However, with the growing demands and increasing number of large-scale water projects such informal institutions designed to resolve small-scale water disputes might not be able to tackle all the complex water disputes, and the water allocations for large sectoral uses. To protect the welfare and water rights of the minority users, and to enhance the equity of resource uses, it may be time to introduce formal water rights by allowing registration of the local water rights at the DDC at the district level, and at VDC at the village level. In that respect, the role of the formal organization, particularly of the DWRC, is crucial for resolving any of these major water use conflicts in the district.

In principle, the DWRC can also take a leading role to initiate coordinating different district-level agencies in the water sector, and the various water use activities. It can potentially provide a forum for dispute resolution even across the districts, and coordinating the water use activities. Due to the administrative setup and the structural weakness, the role of the DWRC until now has not been up to the spirit of the Water Act of 1992, under which it was created earlier. A few changes in the present Water Act (1993) can make the DWRC body active in conflict resolution, as well as intersectoral planning and water use activities in the district, and across the district, for example, increased role of several other local stakeholders like the DDC and district irrigation and water supply agencies, and increased representation from WUAs like the FMIS and water supply associations in the DDC.

7. Integrated River-Basin Management

This chapter assesses the possibility of the adoption of the Integrated Water Resources Management (IWRM) in the context of the Indrawati river basin, and complexities involved in the adoption of the IWRM framework in Nepal. There is no uniform set of standard IWRM framework, which we can be applied to each and every country; rather the designing institutions under IWRM are flexible enough to suit the local context. How to design appropriate water institutions in a country is based on IWRM principles and is still a tricky question in the literature of water resources.

This chapter assesses some of the IWRM issues in the context of integrated river basin Development Planning and Management (RBDPM), where the RBDPM is one of the critical stages of operationalizing the complexities of IWRM principles. The

application of IWRM in the river basin context is operationalized through the improved management of the river basin. This chapter also reviews some of the international literature on RBDPM applicability and some of its concepts and framework in Nepal.

Water sector professionals in Nepal have shown a high-level of interest to have such a review of international literature on the topic in the context of applicability of the IWRM concept, which would assist in water-sector institutional-reforming process in Nepal. Therefore, it is expected that this review of literature on IWRM and IRBDPM will be particularly very useful to the water-sector agencies and researchers in Nepal to assist them in initiating the institutional-development process in Nepal.

7.1 Basic Concept and Framework for River Basin Planning

Integrated river basin Development Planning and Management (RBDPM) is a widely accepted framework for sustainable development of water resources worldwide, particularly more so after the Dublin Conference (1992) on Water and Environment, and the Earth Summit (1992) on Environment and Development (chapter 18 of Agenda 21). Comprehensive management of the water resources using integrated river basin management framework is one of the four key principles adopted by the Dublin Conference in 1992, a significant milestone in managing water resources, for the sustainable use of global water resources.

A river basin is a hydrologically and ecologically functional unit, and it is a focal point for development and planning of a region that also consists of the sustainable area development goal of the resources management and planning. The river basin is basically the catchment area of a particular river, thus a geophysical (hydrological) unit with a high degree of functional integrity, and a large number of interrelationships (with the socioeconomic, institutional and other environments of the catchment area). The river basin is a relatively homogenous system even when upper, middle and lower sections have different conditions and human activities (Barrow 1998; Betlem 1998). The need for integrated management of water resources in the basin is increasingly felt worldwide, especially in the face of increasing water competition among the different sectors, and the water scarcity resulting in water conflicts.

In this context, RBDPM broadly consists of the major activities planning, management, and conflict resolution.

However, the operationalization of the RBDPM largely varies by countries, and regions. RBDPM is an "integrated theme" and "development tool" for social, economic, institutional and environmental (ecosystem based) well-being of a river basin catchment area and, hence, it is much broader than the traditional sectoral approach of water development.

The RBDPM seeks to integrate three interrelated but separately evolved concepts, i.e., a) multipurpose development, b) integrated role for the drainage basin unit, and c) acceptance of intervention to promote development, typically seen to be improvement of social welfare in a regional context (Barrow 1998).

Moreover, the basic concept and meaning of RBDPM has been changed over time, from orderly marshalling of water resources of a river basin to promote human welfare (by UN) in 1970, to a much broader concept, and as a planning tool for achieving a sustainable development goal in the mid-nineties. Present thinking on RBDPM is much

broader, which includes integration of watershed, groundwater, land use, river regulation, human-welfare improvement, health care and most aspects of development (Barrow 1998). The present thinking on RBDPM is that the river-basin resources can be best described as common property resources (CPR). Hence, there is a strong proposition that the RBDPM should be largely undertaken by the public sector since the *laissez-faire* type of market mechanism always under=provides such common property nature of services available from the river basin.

A variety of RBDPM models has been observed in practice. According to Barrow (1998), some of the major kinds of river basin can be grouped into the following six categories:

- single purpose
- duel purpose
- multipurpose
- comprehensive
- integrated
- holistic

The first four terms above are fairly straightforward and self-explanatory, and therefore, only the last two terms of RBDPM are discussed here. Integrated RBDPM goes further than comprehensive management of water resources, and it advocates using water as a "tool" for social and economic development and environment purposes. It provides a solid framework for integrating water planning and management with the environmental, social and economic development (Barrow 1998).

The traditional concept of RBM, which focuses on the single sectoral use of the water resources, has also been in the process of being refined in recent years. The integrated RBDPM includes the application of the sustainable development approach including ecological consideration, broader-scale stakeholders' participation, and increased public consultation during development and uses of water resources.

The holistic approach of RBDPM is a much broader approach than the integrated approach, and it encompasses more on the region and ecology approach and focuses on the river-basin management in the principle of chaotic complexity (of ecological function) in the region. The concept of chaotic complexities is based on the belief that everything on earth is interconnected, and the whole is always greater than the sum of its parts. However, operational setting of the holistic approach is a complex task, and rarely has it been practiced anywhere.

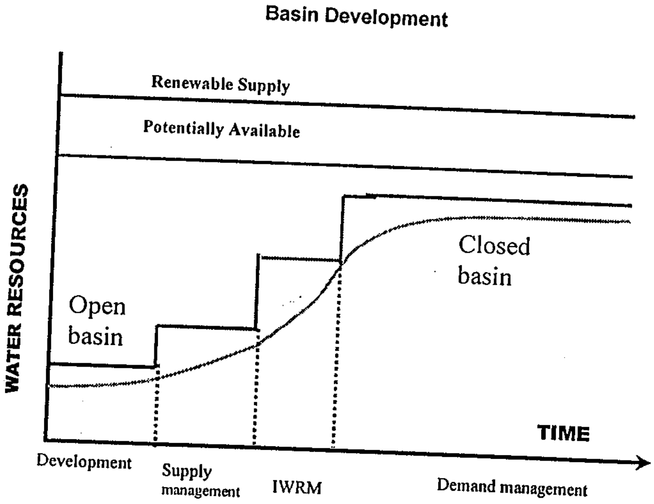
7.2 RBDPM - Operationalization

The framework of RBDPM provides satisfactory coordination of diverse interests of stakeholders within the basin. In practice, RBDPM bodies have varying goals, jurisdictions and authorities. The variety of roles and several kinds of institutional innovations of RBDPM also depend upon the relative scarcity of resources (water) in the locality, whether the river basin is already a closed one, nearly being a closed one, or an open basin, upon the level of technology available, and upon the level of economic development in the region.

What is the most appropriate institutional arrangement for management of the river basins? Certainly, there is no one-size-cut-fits-for-all type of answer available for the above question. The "most appropriate" institutional arrangement depends on the level of economic development, level of water scarcity, and the technology available in the river basin.

In fact, river basin management institutions evolve and change over time in relation to the changes in biophysical factors (hydrological changes) socioeconomic factors, and level of technologies available. The increasing scarcity of the water (rising water demand) and increased value of water induce technical and institutional changes, also called induced technological innovation. The institutional arrangements of any place are not static at any moment, but are dynamic and they change over time with factors like level of scarcity of the water resources, and level of technological changes (North 1990).

Figure 7.1. Different stages of the river basin development, based on the level of water scarcity.



Original source: Skativadivel and Molden, 2001.

A recent IWMI study on variation of institutional arrangements of RBDPM across five selected countries has tried to explain some of the factors affecting the changes in the selected river basin institutions. The study identified four distinct stages in the development of river-basin water resources: i) development or construction stage; ii) supply management, where the emphasis is on managing supplies and water savings; iii) integrated water management stage in which there is growing inter-sectoral competition and the dominant task is setting priorities for the allocation of water among sectors—irrigation, domestic, industry, environment; and iv) demand management stage in which the river basin has become "closed," i.e., all available water has been allocated to various uses and scarcity management becomes a paramount task. Details of some of these issues are found in Samad 2001 and other IWMI publications on river-basin management.

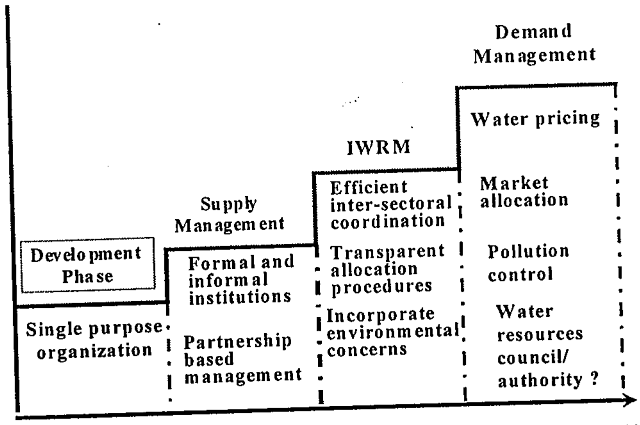
The hypothetical development path of a river basin and the recent issues on river-basin management challenges are also illustrated in figure 7.1 and table 7.1. The figure provides the different stages of the development path in river basin management, and

how the operational policy varies from the development path. Likewise, table 7.1 highlights some of their salient features and factors affecting the variation of river-basin institutions.

These issues and operational strategies on RBDPM as shown in table 7.1 are not mutually exclusive, rather there is considerable overlap in the management challenges and the strategies adopted at any particular stage. For example, when the basin is closed or almost at the closing level then it will require an integrated approach to water resources management, components of supply management and investment in infrastructure development, all together. Basically, then water becomes one of the critical binding factors on the production system, and its allocation needs topmost priority for sustaining the development process, as seen in some of the closing river basins, like Yellow river in China, Jordan river valley in the Middle East, and so on.

In this context, some of the suggestions for the institutional arrangements appropriate as per the different development stages of river basins are given in figure 7.2 below.

Figure 7.2. Basin development stage and institutional complexities involved.



Original Source: Samad, (2001).

Table 7.1. Different operationalization issues and strategies of river basin management in a country, based on the development stage.

Development stage	Supply management	IWRM	Demand management
Infrastructure development	Managing supply distribution	Increases in intersectoral competition	Physical water scarcity
Low value of water	Investing and improving O&M	Intersectoral water conflicts	Water conservation
Economic scarcity	Efficiency in water use	Holistic view on water	High value of water
Low intersectoral competition	Modernization and rehabilitation of infrastructure	Conjunctive management	Shift to high-value use
Simple technology	Diluting pollution	Increasing value of water	Regulating groundwater
Inclusion of poor in the development facilities	Localized/intra-sectoral conflicts	Prioritize allocations	Pollution control
	Emerging pollution/ salinity	Greater environmental concerns	Best possible overall use – basin efficiency
		Safeguarding the interest of the poor and disadvantaged	

Source: Sakthivadivel and Molden 2001; and Samad 2001.

7.3 RBDPM Application in the Context of Nepal

The RBDPM approach could provide several more advantages than the single purpose planning of the river, such as for better management of the ecosystem, or economic use of the resources, or minimizing the conflicts over the water and effective use of the resources. Considering the complexities of the geophysical settings and lower level of development stages, mostly dominated by lower-value water uses, the operationalization of the RBDPM framework in the case of Nepal may need some adjustments and tailoring of the framework as per the specific needs of the economy.

Despite having a common framework, the operational rules and procedures of RBDPM vary by country-specific situations and by regional factors. There are no river basin management operational activities in two nations that are exactly similar. Hence, the application of the RBDPM approach in Nepal has to be also understood in the same context. While applying the RBDPM principle in Nepal, specific considerations are needed on the following specific factors and tailoring the RBDPM framework with due consideration on some of these issues.

a. *Geophysical complexity of the river-basins setting*: Almost all major river basins in Nepal originate in the Tibet region of China, and become tributaries of selected four or five major river basins, which are all again basically subbasins of the Greater Gangatic basin downstream in India. In this context, how to clearly

delineate the hydrological boundary of a river basin within Nepal is a little complicated task, which needs to be analyzed thoroughly. River basin management in Nepal would become different from a river basin management in the context of large nations, in India, Australia, USA, and China, where the originating point and ending (lower-end confluence) of the river are basically confined within the geographical boundary of a nation. While designing operational policy of the RBDPM in Nepal, this factor needs to be considered well in advance and modification of the framework should be done accordingly.

b. *Large variation of the basin hydrology*: In Nepal, the geophysiological and hydrology of the river basin in high mountain areas is vastly different from the southern plains (Terai) of Nepal. Because of this, there is large variation in regional and local environment and other related factors within a short distance (within few kilometers) in a basin. Due to the rugged geography and complex hydrology, the variation of some of these characteristics within the basin, north to south, is much higher than the interbasin variation.

c. *Monsoon dependence and high inter-seasonal variation of river flow*: Large variation of inter-seasonal river flow creates a major hurdle and several other complications on river water uses, and high level of uncertainty. More than 90 percent of the annual river flow occurs within 4 to 5 months of the monsoonal seasons (June to October), and the annual river flow substantially decreases in the rest of the months. In addition, there are less reservoirs and physical control structures in place to facilitate the smooth and controlled allocation of water within and among the sectors. All these factors lead to ineffective monitoring of the river-basin activities, which could further complicate the coordinating process among different agencies involved in the water sector, even if they are all brought under one umbrella of the RBDPM planning process.

d. *Open basins and low level of water withdrawal*: In the basin context, there is less than 5 percent of annual net withdrawal (Mishra 2000) out of the total available water in the river basin. All water flows out of the basin (and in Nepal) within 4 to 5 months of the monsoonal season. The Indrawati water accounting report also suggests that the annual total withdrawal rate in the basin is less then 4 percent of the total water available in the river basin. As shown in figure 7.1 and table 7.1 when the river basin is at open stage there will be little incentives among the stakeholders to participate in the basin planning process and overcome the transaction costs of the river-basin management process. Besides, the lower economic development level in the basin may not provide enough incentives (economic rewards) for involvement and creation of new water institutions including those of RBDPM.

At the lower stage of economic development, the amount of water withdrawal is at a minimum level compared to the available water resources in the basin. At that stage of development, the amount of the naturally available water is also not a constraint to the society, with the exception of some of the arid and semiarid regions. In the initial stage of

the development, there may not be any incentive for having river-basin management institutions since the water is not a binding factor in the economy, and is rather easily available to all, if the needed infrastructures are in place. As the economy starts in the development path, it will demand more water infrastructure and water withdrawal (either for agriculture or industry). When, the economy moves to the transitional stage, then there will be some water-related infrastructure in place, and the competition for water uses will expand, so the demands for the water will also rise. This leads to the need for the allocation management. Detailed discussions on these issues can be found in Sakthivadivel and Molden 2001 and Shah et al. 2001.

What will be the sort of institutional mechanism suitable for the RBDPM in Nepal? The answer depends upon several underlying factors and it needs a careful evaluation. As figures 7.1 and 7.2 and table 7.1 show that there are four broad stages of development in the case of a river basin.

- development (infrastructural)
- transitional (supply management)
- IWRM
- allocation (demand management)

Each of the stage of the river basin requires a different strategy whose details can be found in Sakthivadivel and Molden 2001 and in Samad 2001. Hence, Nepal's present situation of demand and supply of water in a basin is at the developmental stage. Therefore, the framework of RBDPM in the context of Nepal should match the need for water management at this stage.

Small-scale basin studies like the studies done in the Indrawati river basin here can provide information on micro-level water uses, the local water institutions, the water conflicts and the water-sharing mechanism at the local level. However, such a micro-level study may not be able to provide a broad-scale picture of the complexities involved in creating regional institutions with such wider implications, authorities, and activities involved. For this, a separate study will be required with assessing of all the macro- and meso-level factors affecting river-basin-level planning and management in Nepal.

In the case of Nepal, the DWRC, in cooperation with the DDC, could be an already available best institutional setting at this moment to initiate interaction among different stakeholders within a district (subbasin) and intersectoral linkage. This could potentially also start implementing some of the RBDPM principles at the subbasin or basin context. This can be done by coordinating among the different water-sector agencies by slightly altering the present structure of the DWRC in line with river-basin management. The representation of other major local stakeholders in water-sector decision making, within the umbrella of the DWRC, may provide a first step in initiating the concept of river-basin planning, or subbasin-level planning in Nepal. In fact, the Government of Nepal can potentially assess the complexities of the river-basin framework by approaching the planning framework for the Bagmati river basin in the Kathmandu valley, where the water is already scares and river flow almost closed in some of the months in the dry season.

Some sections of the selected river basins in Nepal are at closing level, for example, Bagmati river basin, particularly, the portion within the 20-km stretch of the Kathmandu

valley. Therefore, operationalization and pilot-testing on some of the concepts and principles of RBDPM in Nepal would be very relevant for some portions of the Bagmati river basin, particularly in the Kathmandu valley region. The Bagmati river basin as a whole is an open basin when it flows out 10 km downstream of the Kathmandu valley, and 10 km upstream of the valley range, but it is almost closed within the range of the Kathmandu valley. Therefore, the Bagmati river basin provides a perfect pilot site for testing the viability of river basin planning and implementing approach in the context of Nepal.

8. Conclusions and Policy Recommendations

8.1 Conclusion

This chapter provides conclusions and policy recommendations from the discussions reported in earlier sections. The focus of the discussions and policy recommendations here will be more in respect of the Melamchi water project and its likely impacts in the Indrawati river basin, and the institutional, hydrological and other social issues affecting the process.

Complex sets of water use practices exist in the Indrawati river basin, and it has got a long history of water use practices, and mostly informal water allocations are found. However, the pressure to establish formal and transparent water allocation rules and procedures is also mounting in the local communities, as the water-use activities grow by the day. The various mechanisms developed at local-level water use, and long traditions of relying on FMIS institutions in Nepal, could provide a reliable and a solid foundation for developing an Integrated Water Resource Management (IWRM) framework at the basin level. This also assists in the operationalization of the IRBDPM framework for managing the river resources in the basin. This involves consideration of economic, social and environmental aspects while managing the water resources in the river basin.

Melamchi Water Project

There was some skepticism among some of the local stakeholders, including local institutional stakeholders, about the water availability in Melamchi after the planned diversion of water to the Kathmandu valley. Even though the Melamchi project has got a plan to release of 0.4 m^3/s of water even in the dry season, as a minimum environmental flow requirement of the project. These different perceptions and skepticism of the local stakeholders about the project could be mainly because of inadequate interactions between project officials and local stakeholders, and inadequate sharing of information by the project officials. Other than that, the case studies revealed that the local communities were not very much aware of the proposed the Melamchi Inter Basin Water Transfer (IBWT) Project, and its likely other impacts on their livelihoods in the basin. The minimal involvement of the local communities in the decision-making process of the project could be one of the reasons for this local unawareness.

Considering the sufficient water availability in the Indrawati river basin, the proposed water diversion project could have a minimum level of adverse effects on the local

agricultural practices, except the immediately downstream reaches of the Melamchi project intake site. However, this could not be substantiated much due to the unavailability of adequate data. The Melamchi project has proposed various compensation packages worth more than US$18 million to mitigate some of these negative environment and social impacts on the livelihood of the local population. Considering the previous water-infrastructural projects, this level of compensation is considered to be fairly high, particularly considering the level of economic development in the area.

The other major implications of MWSP could be on the existing institutional practices of water management at the local level. Removing a large volume of water is likely to change some of the hydrologic characteristics and river ecology, and may create additional stress on the present institutions responsible for water allocations and conflict resolutions. The question is whether these traditional existing community-level institutional arrangements can effectively cope with the institutional crisis brought about by this level of external shock, which in the past were basically designed only for small-scale water allocations. However, we can learn a lot from the existing local-level institutions (formal and informal) to design any advanced set of institutional mechanism in the basin.

Water Balance Situation

The water balance study in the Indrawati river basin showed that on the whole this is an open basin; however, water stress is more pronounced in the subbasin and its tributaries, which may be near to being a closed subbasin in some of the dry months. The present process consumption level of water in the Indrawati river basin is at minimal level, and about 90 percent of the utilizable water outflow moves out of the basin as river outflow. Therefore, the proposed water diversion plan will have little impact on the Indrawati basin hydrology, except for some water scarcity felt in the 1-or 2-km reaches of the Melamchi river immediately downstream of the project intake site, particularly during the dry months from February to May. The planned water diversion is merely 2 percent of the average annual river outflow from the basin (even in the driest year). In addition, in managing the environmental aspect of management, the Melamchi project has got a plan to maintain at least a 0.4 m^3/s of water flow at the downstream of the project intake site, as a minimum environmental flow for aquatic ecosystem, even in the driest season. This will potentially minimize the water transfer impacts on the local aquatic environment. However, it is not clear whether this minimum flow would be sufficient to sustain the other water use activities in the downstream reaches. The water use planning in this subbasin is constrained due to the spatial location of the feeder tributaries and therefore, all these factors need to be considered in the development of future water-use activities in the Melamchi subbasin, after the planned diversion of water out of the basin.

Water Institutions and Allocations

In the Indrawati basin, the present water allocation among various water sectors is at a minimum level compared to the water availability in the basin, which is mostly governed by the customary practices. Formal water allocation rules have not yet been developed in

the basin mainly due to sufficient water availability, and the low level of economic development stage in the basin areas. Some of the major water use sectors are: irrigation systems, the water turbine mills, the ghatta and the micro-hydro. However, the competition for the use of water is increasing mainly due to the development of the micro-hydro, new irrigation systems, and water mills, etc.

The customary practice of water allocation provides first priority to irrigation over other uses. Therefore, farmers are in favor of keeping the same customary-based water allocations rather than introducing any other allocation mechanism (formal water rights), which is likely to equally favor all competing water users in the basin. During the study it was revealed that some of the large farmers (local elites) do not want effective UC functioning in the locality, as it may hinder their self-interest, and as it could increase the collective bargaining power of the small farmers and other minority community members in the society.

The conflict among the water users is less pronounced as the water availability for various uses is not a binding constraint, except for occasional water-related disputes seen in the communities mainly in the dry season (January to May). Water-related disputes have been reported from some tributaries, which are usually settled by community-level mutual understanding and informal negotiation. Likewise, the dispute on water uses between irrigation and water-turbine-operated mills and/or the micro-hydro sector is particularly contained due to the informal arrangement in scheduling of the operation of the water mill in the day and irrigation schedule in the night, respectively.

The increasing water activities in the basin may, in the future, encourage the users to develop a formal water-allocation mechanism and a new institutional arrangement, as the existing informal institutions may not be able to cope with the external shocks brought about by mega-projects like the MWSP, and other hydroelectric projects. Although the basin is an open basin, the water availability across the basin is not evenly distributed to fulfill the needs of all the users in all seasons. Some changes may be required in the existing water allocation procedure, flexible enough to adjust for the average flow and the minimum flow.

The VDCs and DDCs contribute to the development of water resources at their jurisdictions especially for the construction of the micro-hydro, irrigation systems, and so on. Considering its role in other development sectors in the district, the DDC is already playing a significant role in water resources development in the district, which is more than what is provided by the existing national legislation on water (1992).

At the moment, the DWRC is not playing an effective role in planning for local water use activities in the district, despite a larger role envisaged by the existing Water Act (1992) while the local DDC, particularly the *Sindhupalchowk* district, is interested in to playing a bigger role in development of water resources sector in the district in spite of its minimum statutory role in water sector. It is likely that such conflicts and friction in the systems and in the rules and regulations, and the ongoing court cases between the local DDC and the central government, may positively assist in the evolution of better and efficient water institutions in Nepal.

Social Exclusion and Equity in Water Uses

There are no established rules and regulations at the local level for securing water rights in relation to the development of new water projects, and water use activities in the basin. New water-related projects are implemented in the basin, utilizing the same source of water, without taking into account the existing water use rights of the prior appropriators. The first users' water rights are encroached upon without giving any compensation to them. In particular, this is already problematic in the case of water competition between farmers and ghatta owners and/or mill owners. The mill owners are resourceful persons in the community so they can exercise their social influence and negotiate their interest; however, the ghatta owners are usually from the marginal section of the society and they are usually the victims of such informal water rights and informal water allocation practices. The Melamchi project should also provide direct and targeted compensation package to the ghatta owners and other minor water users, and those who are likely to be displaced from the Melamchi project activities in the basin.

The need for the household's compulsory contribution of cash during the development of new water projects has also become a source of exclusion of households in the project's service-use activities later on, particularly the poor and marginal households that cannot contribute cash for the project activities. Inclusion in the irrigation sector has helped increase the agricultural production and reduce poverty of the included families and helped secure water rights. In the case of hydropower, drinking water and sanitation facilities, inclusion of a particular household means access to better facilities as well as increased family income and a comfortable life style. This has a large wealth impact to one group of households over the other, which is excluded from these services.

8.2 Policy Recommendations

The major policy recommendations forwarded from this study are grouped into the following subheadings below, to cover the nature and scope of the case studies done in the basin earlier.

Melamchi Project

- The project should conduct more local-level consultations and information sharing with the local stakeholders in the basin. There are still certain levels of skepticism about the project among the local community members and local stakeholders, despite the fact that the project has a comprehensive compensation package, including the maintaining of a minimum environment flow (0.4 m^3/sec) immediately downstream of the project intake site. Frequent consultations and improved information-sharing among the local stakeholders will avoid such criticism.
- The project compensation package should be more targeted to the communities and households directly and adversely affected by the project activities, and this includes some of the ghatta owners and the FMIS groups immediately downstream of the project intake site.
- There is a need for a study on costs and benefits of water uses in various sectors, in the donor as well as in the recipient basin (Kathmandu), especially in relation to

interbasin water transfer. This deserves special merit for improved quantification of social and economic values (costs) of the interbasin water transfer decision, and sharing of the social benefits (costs) across the sectors. This information will be particularly useful for the effective management of the water resources and the efficient utilization of the other resources in the donor basin as well in the recipient basin.

- There is a need to continue an effective process documentation research (PDR) of the Melamchi project, particularly of implementation of the project compensation package to provide timely feedback to the project authority. The government experiences in dealing with the project compensation package and rehabilitation task under the Melamchi project will also be equally useful for implementing other water infrastructure projects in the country. The national workshop discussions of this project in Kathmandu also concluded that the PDR should be continued in the Indrawati basin to understand the complexities involved in large-scale interbasin water transfer out of the basin, particularly, its other impacts on social, economic and environmental aspects at regional as well as micro levels, and the local communities' strategies to cope with the changed situations.
- There is a need for further detailed socioeconomic research on quantifying the costs and benefits associated with the water transfer project including quantifying some of the environmental costs and the total benefits to the society, which would help to improved understanding of impacts of the water transfer project. These include the impact analysis of the economic activities, environment, livelihood of the local people, and social and welfare gain in the recipient basin (Kathmandu). This will assist the negotiation process of the local community in securing the project-related compensation benefits and protecting their water rights. The improved understanding of these factors will also assist the Government of Nepal to properly design other water resource projects in Nepal. It would also help in understanding the institutional arrangement that may emerge to cope with the changes brought about by the project.

Water Accounting

- A detailed water balance study should be conducted at and around the Melamchi project intake site to draw a precise picture of the local-level impacts of the project in the basin. This will provide an accurate estimate of the water available immediately downstream of the project intake site. This stage is still confusing in Nepal. However, the study will facilitate the development of appropriate institutions to cope with the impacts. Besides, it would assist in learning the precise impact of interbasin water transfer on the economic, social and environmental aspects of the local community.

Water Institution

- Given the present administrative and organizational setup in Nepal, there is a need to make a distinction between the regulative and planning function of government organizations at the district level to facilitate improved management of the water resources and intersectoral coordination at the local level.

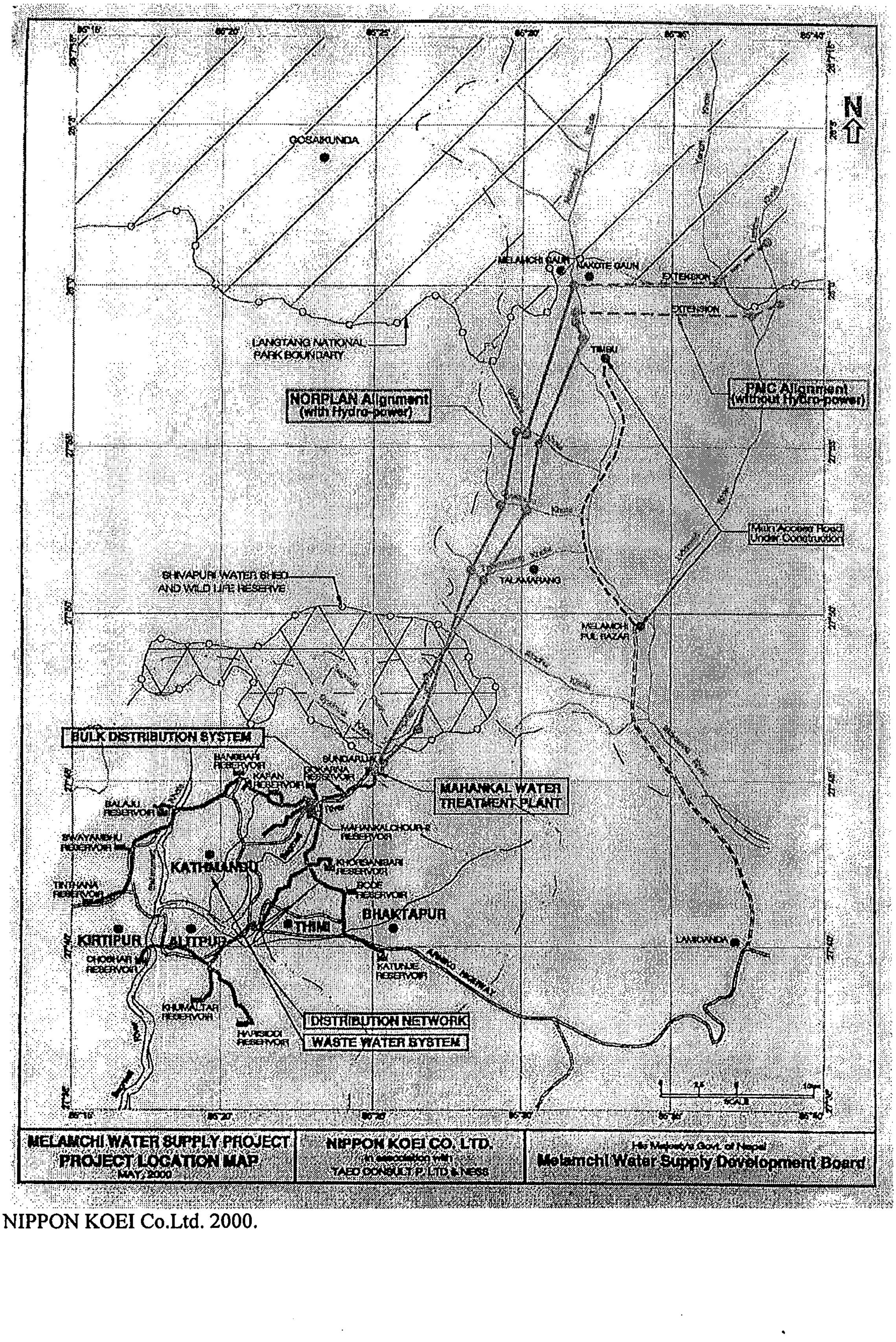
- At present, the functions of the DWRC are more regulative (legislative) in nature and, therefore, its structural setup needs to be reorganized to discharge an effective coordination across the sectors in the district. This can be altered by involving some of the local water-sector stakeholders in the DWRC committee, and representatives from FMIS and other water users. It may be better if the *ex-officio* chairperson and secretary of the DWRC are from the developmental agency (DDC and DOI), and not from the administrative sector. The existing structure of the DWRC needs to be tailored to fit the water-sector acts as well as other sectoral acts in the country. Moreover, all of these adjustments also need to be consistent with the decentralization in decision making and participation of local stakeholders in the water-sector decision-making process, which is also the core objective` of implementing the IWRM framework in managing the water resource.
- The DDC could be the appropriate agency for the planning function of water resources, in particular coordinating the development of water resources from private, community and other agencies at the district level when the activity covers several VDCs. In addition, in principle, the DDC is also responsible for preparing the periodic and annual District Development Plans for various other development sectors for the district.
- Close coordination between the DDC and the DWRC is required to prepare an integrated water resources plan for the district. It may be better, if the DWRC would work as a technical body of the DDC. Because of the conflicting nature of the two national acts, Water Act (1992) and Decentralization Act (1995), at present there is essentially a functional-level confusion between the DDC and the DWRC.
- If the functions of the DWRC in the legal framework are modified and strengthened in light of the Decentralization Act (1995), then it would facilitate better coordination of water-sector agencies and water-use activities within and across the adjacent districts. In turn, the success of functioning of the DWRC may lead to the evolution of the river basin planning process in Nepal.
- The role of local-level elected bodies (VDC and DDC) in the water sectors should be strengthened for better participation of the local stakeholders in the district. The VDC would be the appropriate agency for registration of the small-scale water-use activities at its jurisdiction, like ghatta and water mill, etc. The VDC should be even authorized to collect some level of taxes (as a registration fee) from some of these water projects within their jurisdiction. For a relatively medium-scale water project, like micro-hydro or small-scale hydropower (up to 5 or 10 MW), and water mills, the DDC may be an appropriate agency to coordinate at the district level as well as with the concerned sectoral agencies at the center. Then, the central government can better concentrate its efforts on the development of large-scale water projects.
- The century-old community-developed and practiced-innovative water use institutions could somewhat buffer the extent of the shock, and could also provide a sound basis for developing the IWRM at the basin level. Therefore, the process of building a new institutional arrangement, if based on existing institutions, will ensure **its success in advance. Therefore, there is a need for further exploration on how the community success in FMIS type of water-resources development process in Nepal can also be made effective at the higher tier resources management there, including managing the water and other natural resources.**

Exclusion and Inequity in Water Uses

- There is a need to develop an effective mechanism for the protection of the water rights of the prior appropriators (first users) and to address the need of the poor and marginal groups while developing any new water use activities, especially considering the dry-season water availability. The important aspect is to develop the capacity of the minority community to enable its members to participate in the decision-making process in water resources use. Strengthening of the institutional and negotiation procedures should be done so that the voice of the marginal water users is be properly heard in the decision-making process.
- There is a need to have a formal registration on water rights of the local-level minority use (like ghatta owners) at the local-level agency, like the VDC. This would greatly assist in designing a proper compensation mechanism during the intersectoral water transfer in the case of the Melamchi project, or implementing any new water project in the basin. This would provide a formal basis for negotiation between the existing water users and the new (potential) users and designing an effective benefit-sharing mechanism and project-compensation package, so that it would allow movement of the resources from lower-value uses to higher-value and pave the way for the development process, with due consideration to the equity dimension of the resource uses. The fear of inequity over future resources use is the usual skepticism on any of such water development project almost everywhere. In that sense, the securing of entitlement of water users, even of the minority users, would greatly increase their bargaining power during the negotiations over the project-compensation package.

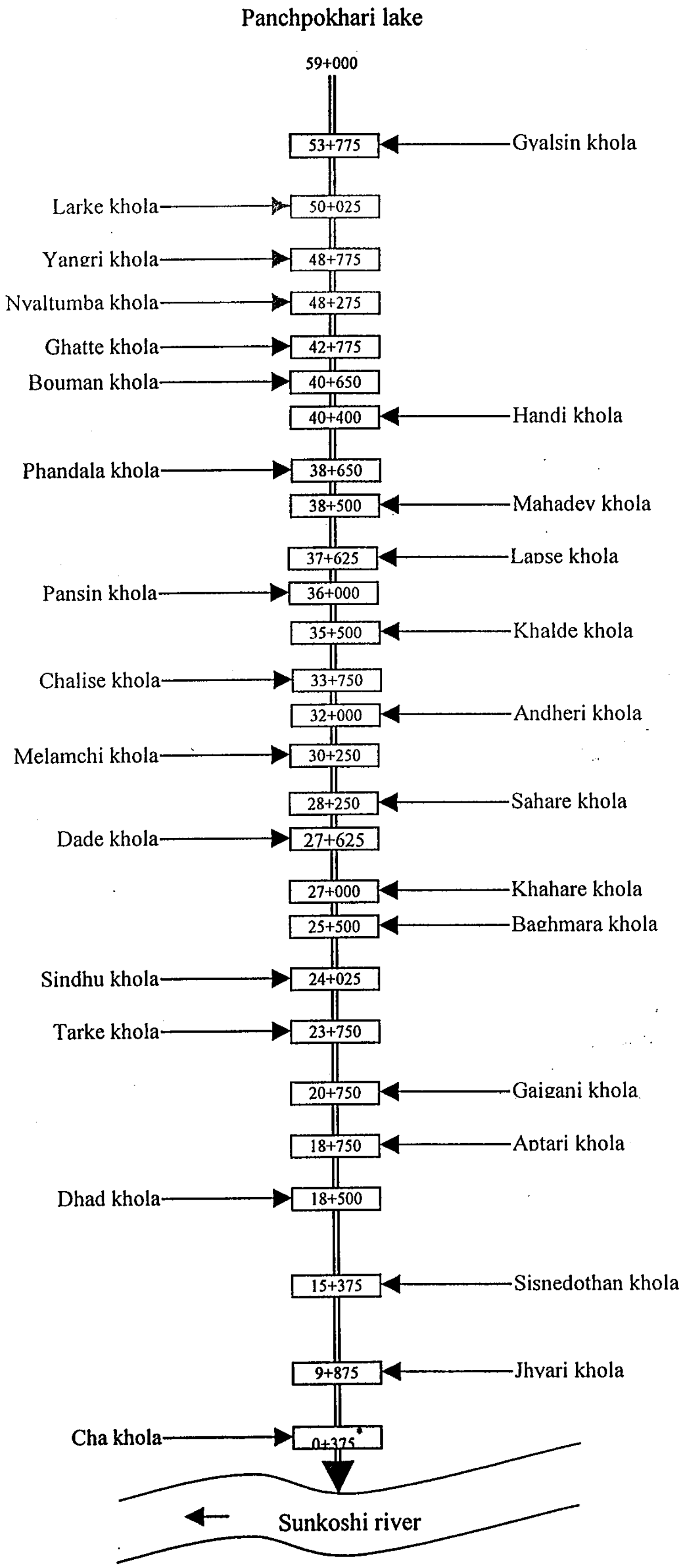
Appendix

Appendix figure 1. Melamchi diversion scheme, engineering sketch.



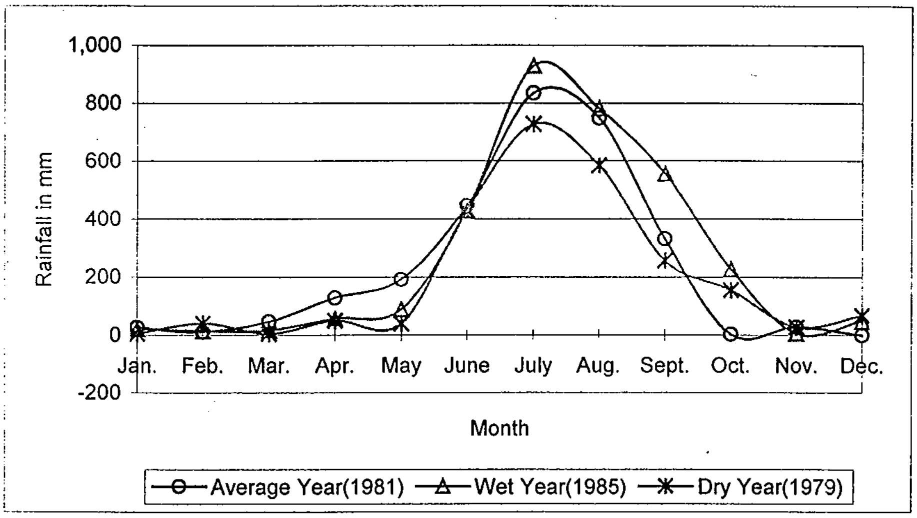
Source: NIPPON KOEI Co.Ltd. 2000.

Appendix figure 2. The Indrawati river system.



* Distance measured from confluence with Sunkoshi river (in km).

Appendix figure 3. Comparison of monthly rainfall for selected study years.



Appendix table 1. Brief description on sectoral water uses in the selected tributaries.

Tributaries	Length (in km)	Catchment area (in km$^{2)}$	Benefited VDCs	Uses of Water	Remarks
Melamchi	41	346.7	Helambu, Kiul, Ichowk, Palchowk, Mahankal, Dubachower, Talamarang, and Melamchi.	19 irrigation systems, several drinking-water projects, one micro hydropower plant, ghattas and water mills	- Palchowk Beltar Bhattar (150 ha), Halade Taruki Besi (135 ha), Gure Besi (135 ha), Chiuri Kharka Kiul, Palchowk (220 ha, planned), Talamarang, Melamchi Tar (83 ha – ongoing) irrigation systems are the main users of Melamchi water. - Melamchi water (from the river itself) is used only for irrigating dry-season crops. - There is one existing micro hydropower project, of 10 kW capacity owned by one individual. - None of the drinking-water projects uses Melamchi water. - Most of ghattas and water mills run in winter and about half of ghattas are shut down during summer due to the floods in Melamchi river. - The systems, which are fed by Melamchi, have adequate water available from the river. However, water shortage is faced in the dry seasons mainly due to inappropriate operation and maintenance of the systems. - Among the selected systems in the Melamchi tributary, only Simbhandar kulo has multiple water use: irrigation, ghatta, water mill and micro hydropower.
Handi khola	13.75	52	Thangpaldhap, Thangpalkot and Gunsa	12 irrigation systems, 2 existing and one planned micro hydropower projects, 10 ghattas and 2 water mills	- All irrigation systems, mills and ghatta run throughout the year; no felt water scarcity in this subbasin.
Mahadev khola	6	16	Thangpaltar, (Thangpaldhap) and Bhotanamlang	11 irrigation systems and 10 ghattas	- About half the number of ghattas do not get sufficient water throughout the year.

Source: Field survey 2000; and findings of case studies in the Indrawati river basin.

Appendix table 2. Average monthly and yearly discharge (in m^3/sec) at the Dolalghat station no. 629.1.

Year	Jan.	Feb.	Mar.	Apr.	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly
1975	22.2	18.7	13.8	18.3	23.5	74.9	248	279	284	140	52.3	30.7	100.45
1976	23.4	17.8	12.1	13.5	29.1	118	144	232	190	68.5	36.4	23.2	75.7
1977	18.4	14.3	11.7	16.7	20.6	102	171	150	122	81.9	47.7	25.5	65.2
1978	25.7	20.1	20.7	25.6	37.4	93.5	265	366	227	120	59.8	29.8	107.6
1979	16.5	21.8	14.6	15.4	15.7	79.7	282	194	125	61.5	39.8	32.6	74.9
1980	18.5	12.3	12.8	13.6	14.3	103	237	260	194	88.8	53.6	35.2	86.9
1981	24.9	17.4	14	20.5	40.3	104	235	276	205	48.8	33.3	21.4	86.7
1982	19.2	28.9	36.2	42	42.5	112	205	233	172	82	35.3	21.5	85.80
1983	26.7	23.2	22.6	19	35.8	49.2	225	233	217	62.8	39.1	24.7	81.5
1984	18.5	14	11.1	10.4	17.3	57.9	462	440	364	71.9	33	24.2	127.0
1985	11.6	11.2	10.5	8.96	19.7	59	296	345	319	134	69.7	39.1	110.3
1986	22	15	10	12	11	64	219	237	284	135	51	30	91
1987	21	17	15	18	24	79	297	309	253	92	45	27	100
1988	19	18	20	18	29	146	360	282	222	77	44	32	106
1989	29	21	20	17	27	81	273	326	164	90	35	19	92
1990	14	12	10	11	24	92	222	215	151	69	33	23	73
Average	20.62	17.7	16.0	17.5	25.7	88.4	258.8	273.6	218.3	88.9	44.3	27.5	91.4

Appendix table 3. Water account result for wet, average and dry year in the Indrawati river.

S. N.	Component	Subcomponent	Wet Year (1985)		Average Year (1979)		Dry Year (1981)	
			Volume (million m^3)	% of Net Flow	Volume (million m^3)	% of Net Flow	Volume (million m^3)	% of Net Flow
1	Gross inflow	a) Rainfall	3,933.00		3,461.00		2,952.00	
2	Storage changes	a) Surface storage	0		-0.04		0.03825	
		b) Ground storage	0		-81.15		88.15	
3	Net inflow		3,933.00		3372.81		3,040.2	
4	Process Depletion	ET of paddy	32.50	0.83	27.40	0.81	31.70	1.04
		ET of paddy (spring)	4.60	0.12	9.30	0.28	4.07	0.13
		ET maize (winter)	19.53	0.50	17.40	0.52	26.85	0.88
		ET maize (summer)	18.70	0.48	20.50	0.61	17.99	0.59
		ET wheat	8.80	0.22	12.89	0.38	8.35	0.27
		ET potato	1.60	0.04	4.20	0.12	1.30	0.04
		ET pulses	3.50	0.09	1.10	0.03	1.60	0.05
		ET vegetables	1.27	0.03	1.20	0.04	1.20	0.04
		ETmillet	28.24	0.72	0.79	0.02	0.64	0.02
		ET oil seeds	0.73	0.02	22.90	0.68	28.20	0.93
		ET fruits	8.00	0.20	8.10	0.24	7.50	0.25
		Domestic uses	1.49	0.04	1.49	0.04	1.49	0.05
		Animal uses	0.93	0.02	0.93	0.03	0.93	0.03
		Subtotal	129.89	3.30	128.20	3.80	131.82	4.34
5	Non-process depletion (beneficial)	a) ET forest	325.21	8.27	355.81	10.55	310.71	10.22
		c) ET grazing land	54.73	1.39	56.22	1.67	53.15	1.75
		d) ET homestead and Others	107.30	2.73	114.42	3.39	102.14	3.36
		Subtotal	487.24	12.39	526.45	15.61	466.01	15.33
6	Non-process depletion (non-beneficial)	ET barren land, flood plain and water body	84.87	2.16	87.98	2.61	82.70	2.72
7	Outflow	Runoff	3,512.53	89.31	3,082.29	91.39	2,621.63	86.23
	Sum of depletion and surface runoff		4,214.53		3,824.93		3,302.16	
	Sum of net inflow		3,933.00		3,372.81		3,040.2	
	Calculation error		-281.53		-452.11		-261.95	

Source: Mishra 2000.

Appendix table 4. Water balance result with and without the Melamchi water supply project.

Month	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sep	Oct	Nov	Dec	Annual
Before Project													
Inflow in the basin (rainfall) mm	21.9	6.3	24.1	35.7	146.5	262.3	686.1	750.0	466.4	80.1	0.0	11.5	2490.7
Inflow in the basin (rainfall) million m^3	7.2	2.1	7.9	11.8	48.3	86.5	226.4	247.5	153.9	26.4	0.0	3.8	821.9
Inflow in the basin (m^3/sec)	2.7	0.9	3.0	4.5	18.0	33.4	84.5	92.4	59.4	9.9	0.0	1.4	25.8
Outflow at confluence with Indrawati (m^3/sec)	6.6	4.6	5.2	5.5	6.2	14.3	57.9	77.4	51.0	17.5	10.8	7.7	22.0
Outflow at confluence (million $m^{3)}$	17.6	11.2	13.8	14.3	16.5	37.1	155.1	207.2	136.5	46.8	28.9	20.6	705.7
Process and non-process depletion in million m^3	4.11	0.96	7.06	14.76	33.73	38.03	35.11	30.73	24.33	19.02	0.03	1.02	208.88
Outflow at Melamchi intake (m^3/sec)	2.8	2.2	2.0	2.2	2.5	6.4	25.8	34.4	21.4	8.1	4.6	3.4	9.6
Added flow from tributaries between intake and confluence point (m^3/sec)	3.8	2.5	3.2	3.3	3.6	8.0	32.1	43.0	29.5	9.4	6.2	4.3	12.4
Process domestic requirement (m^3/s)	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Diversion required for irrigated agriculture (m^3/sec)	0.20	0.25	0.33	0.40	0.18	0.00	0.00	0.00	0.00	0.00	0.15	0.17	0.14
Balance runoff at confluence (m^3/sec)	6.36	4.35	4.83	5.10	5.97	14.31	57.91	77.35	50.95	17.47	10.63	7.52	21.90
After Project													
Melamchi project supply (m^3/sec)	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97	1.97
Outflow at confluence with Indrawati (m^3/sec)	4.60	2.64	3.20	3.54	4.19	12.35	55.95	75.40	48.99	15.51	8.82	5.73	20.08
Outflow at Melamchi intake (m^3/sec)	0.84	0.18	0.00	0.28	0.56	4.40	23.88	32.40	19.48	6.08	2.62	1.40	7.68
Added flow from tributaries between intake and confluence point (m^3/sec)	3.76	2.46	3.20	3.26	3.63	7.95	32.07	43.00	29.52	9.43	6.20	4.33	12.40
Process domestic requirement (m^3/sec)	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013	0.013
Process depletion requirement (irrigated agriculture- m^3/sec)	0.15	0.15	0.24	0.34	0.37	0.34	0.30	0.26	0.21	0.15	0.09	0.11	0.23
Irrigation diversion requirement (m^3/sec)	0.20	0.25	0.33	0.40	0.18	0.00	0.00	0.00	0.00	0.00	0.15	0.17	0.14
Outflow at confluence with irrigation system at full potential (m^3/s)	4.39	2.38	2.86	3.13	4.00	12.34	55.94	75.38	48.98	15.50	8.66	5.56	19.94

Note: The drinking water requirements for 28,182 persons in the basin estimated to be about 0.13 m^3/sec, or @ 40 liters per day per capita, which are met from the nearby spring sources.

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