Preface

Water is one of the principal physical resources that can play a major role in enhancing the pace of overall development of a country. Sustainable development of water resources can significantly contribute to poverty alleviation and economic growth. Recognizing the need for comprehensive management and development of water resources for realizing optimal benefit, His Majesty's Government of Nepal (HMGN) started formulating Water Resources Strategy (WRS) in 1996, and approved it in January 2002. The goal defined by the strategy is to improve the living standard of Nepalese people in a sustainable manner.

In order to implement the activities identified by the WRS, the Water and Energy Commission Secretariat (WECS) started formulating National Water Plan (NWP) in 2002, which was approved by HMGN in September 2005. The NWP recognizes the broad objectives of the WRS and lays down short-, medium- and long-term action plans for the water resources sector, including investments and human resource development. The NWP attempts to address environmental concerns, which is reflected by the incorporation of the Environmental Management Plan in the document. This Environmental Management Plan will contribute to maximizing positive impact and minimizing or mitigating adverse impact in line with the environment sustainability concerns.

A team of consultants, experts, academics, professionals and stakeholders related to the water resources sector contributed to preparing the NWP document. During the process, HMGN formed a core committee comprising representatives of various ministries, government departments, experts and academics to provide guidance to the task forces engaged in various sub-sectors. The NWP is expected to fulfil the aspirations of the Nepalese people in respect of the development of the water resources sector in the country.

The Plan will be reviewed periodically to address the emerging development needs and the experience gained during the process of its implementation.

Active support of bilateral and multilateral donors, government line agencies, non-governmental organizations, international non-governmental organizations and other stakeholders is expected for the successful implementation of the Plan.

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Shital Babu Regmee
Act. Executive Secretary
Water and Energy Commission Secretariat

List of Acronyms and Abbreviations

ADB/N	-	Agricultural Development Bank Nepal
AGDP	-	Agricultural Gross Domestic Product
APP	-	Agricultural Prospective Plan
ASASIP	-	Accelerated Stand-Alone Sanitation Improvement Program
B/C	-	Benefit Cost Ratio
BCM	-	Billion Cubic Meters
CBO	-	Community Based Organization
CBS	-	Central Bureau of Statistics
CIF	-	Cost, Insurance and Freight
CMIASP	-	Community Managed Irrigated Agricultural Sector Project
DDC	-	District Development Committee
DHM	-	Department of Hydrology and Meteorology
DNPWC	-	Department of National Park and Wildlife Conservation
DoED	-	Department of Electricity Development
DoF	-	Department of Forest
DoI	-	Department of Irrigation
DRWSSDF	-	District Rural Water Supply and Sanitation Development Fund
DSCWM	-	Department of Soil Conservation and Watershed Management
DoS	-	Department of Survey
DSS	-	Decision Support System
DTO	-	District Technical Office
DTW	-	Deep Tub well
DWA	-	District Water Assembly
DWIDP	-	Department of Water Induced Disaster Prevention
DWRC	-	District Water Resources Committee
DWSS	-	Department of Water Supply and Sewerage
EIRR	-	Economic Internal Rate of Return
EMP	-	Environment Management Plan
EPC	-	Environmental Protection Council
ETFC	-	Electricity Tariff Fixation Commission
FAO	-	Food and Agriculture Organization
FMIS	-	Farmer Managed Irrigation Systems
FOB	-	Free on Board
GDP	-	Gross Domestic Product
GHG	-	Green House Gas
GLOF	-	Glacial Lake Outburst Flood
GW	-	Ground Water
GWRDB	-	Groundwater Resource Development Board
Ha	-	Hectare
HDI	-	Human Development Index
HMG	-	His Majesty's Government
HMG/N	-	His Majesty's Government of Nepal
HRD	-	Human Resource Development
IDNDR	-	International Day for Natural Disaster Reduction
INGO	-	International Non-governmental Organization
INPS	-	Integrated Nepal Power System
IWRM	-	Integrated Water Resources Management

IWT	-	Inland Water Transportation
KV	-	Kilo Volt
KVWSSP	-	Kathmandu Valley Water Supply and Sanitation Program
KWh	-	Kilowatt hour
LOF	-	Lake Outburst Flood
LGIs	-	Local Government Institution
LSGA	-	Local Self-Governance Act
MHS	-	Multiple Harvest System
MCM	-	Million Cubic Meters
MoAC	-	Ministry of Agriculture and Cooperative
MoEST	-	Ministry of Environment, Science and Technology
MoFSC	-	Ministry of Forest & Soil Conservation
MoHA	-	Ministry of Home Affaires
MoHP	-	Ministry of Health and Population
Mo IC	-	Ministry of Information and Communication
MoLD	-	Ministry of Local Development
MoPE	-	Ministry Population and Environment
MoST	-	Ministry of Science and Technology
MoWR	-	Ministry of Water Resources
MPP	-	Multipurpose Projects
MPPW	-	Ministry of Physical Planning & Work
MT	-	Metric Ton
MTEF	-	Mid-Term Expenditure Framework
MTWSSP	-	Major Towns Water Supply and Sanitation Program
MUV	-	Manufacturing Value Index
MW	-	Megawatt
MWSDB	-	Melamchi Water Supply and Development Board
NDC	-	National Development Council
NDRA	-	Natural Disaster Relief Act
NEA	-	Nepal Electricity Authority
NGOs	-	Non-governmental Organizations
NPC	-	National Planning Commission
NPV	-	Net Present Value
NWP	-	National Water Plan
NWSC	-	Nepal Water Supply Corporation
NWSRC	-	National Water Supply Regulatory Commission
O&M	-	Operation and Maintenance
PPA	-	Power Purchase Agreement
PIR	-	Poverty Imapacting Ratio
RBM	-	River Basin Management
RBO	-	River Basin Organizations
RWSSP	-	Rural Water Supply and Sanitation Program
SAARC	-	South Asian Association for Regional Cooperation
SALT	-	Special Area Land Treatment
SEA	-	Strategic Environmental Assessment
STWSSP	-	Small Towns Water Supply and Sanitation Program
SW	-	Surface Water
VDC	-	Village Development Committee
WEC	-	Water and Energy Commission
WECS	-	Water and Energy Commission Secretariat
WID	-	Water Induced Disaster
WIRS	-	Water Resources Information System
WMO	-	World Meteorological Organization

WRS	-	Water Resources Strategy
WRSF	-	Water Resources Strategy Formulation
WSS	-	Water Sector Strategy
WSSISP	-	Water supply and Sanitation Institutional Strengthening Programme
WUA	-	Water User Association
WUC	-	Water Users' Committee
WUG	-	Water Users's Group

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Part A. National Water Plan: The Context

1. General Context

1.1 Physical Setting

Nepal is predominantly a mountainous country formed due to the uplift of the Indian tectonic plate following a collision with the Asian plate. The country can be divided into five physiographic regions, viz High Himalayas, Lesser Himalayas (High Mountains), Middle Mountains (the Mahabharat Range), Siwaliks (the Churia Range) and the terai plains.

Due to orographic features, Nepal experiences a wide range of climates varying from the sub-tropical to the Alpine type as the elevation varies from 64 metres (m) above sea level to 8,850 m (world's highest mountain peak, Mt Everest) within a span of less than 200 km. The country also experiences heavy rains during June to September due to the south-westerly monsoon, which accounts for 80% of the total rainfall, and winter rains, during November to January, accounting for the rest of the rainfall. The climatic conditions of Nepal are summarized in Table 1.1.

Table 1.1: Climatic Conditions of Nepal

Ecological Belt	Climate	Average Annual Precipitation	Mean Annual Temperature
Mountain	Arctic/Alpine	Snow/150 mm-200 mm	$<3^0$c–10^0c
Hill	Cool/warm Temperate	275 mm-2300 mm	10^0c–20^0c
Terai	Sub-tropical	1100 mm- 3000 mm	20^0c–25^0c

The average annual rainfall of the country is about 1,530 millimetres (mm). But there is sharp spatial and temporal variations in rainfall. The pattern of rainfall distribution varies in both north-south and east-west directions. The monsoon rain is more intense in the east and goes on declining westwards, while the winter rain falls heavily in the west and goes on declining to the east. The rainfall pattern and the existing rugged and mountainous topography have resulted in the existence of a rich natural bio-diversity in Nepal, the importance of which is yet to be adequately realized.

1.2 Social Setting

Nepal is inhabited by more than sixty caste and ethnic groups of people belonging to Indo-Aryan and Tibeto-Mongoloid stocks. The majority of the people practise Hinduism, whereas Buddhism is the second largest religion. The population of Nepal was 23.15 million in 2001 (CBS 2001), and, with the assumed growth rate of 2.25%, the population in 2003 is estimated at 24.21 million. The density of population has now reached 164 per sq km.

Human Development index (HDI) is a measure of human development, and is considered one of the important indicators of the overall development of any country. The HDI of Nepal has been computed at 0.504 and, according to the recent Human Development Report 2004, the country ranks 140 among a total of 177 countries. Nepal, with an annual per capita Gross Domestic Product (GDP) estimated at around US$248, is labelled as one of the least developed countries.

The life expectancy at birth is about 61 years, with the average literacy rate of 53.7% (population over the age of six). Net primary school enrolment has, however, moved upwards to 80.4% and infant mortality rate has come down to 64 per 1000 births. Access to drinking water supply has been provided to 71.6% of the population, at the end of July 2001.

Poverty in Nepal has persisted for decades, despite the implementation of nine periodic plans. Poverty is widespread with around 38% of the population living below the prescribed poverty line.

Around 80% of the poor work in the agriculture sector, generally on small and dispersed plots of low-quality land. The demand for such agriculture labour, however, is highly seasonal, and the opportunity for non-farm employment is low. As a result, there is insufficient work and underemployment lingers around 50%. The number of absolute poor has nearly doubled over the past twenty years.

Population Projection

Population projection by the then Ministry of Population and Environment (MoPE) has been used for national- and regional-level population estimates in the plan. However, urban population is estimated separately in the National Water Plan (NWP) as small towns do not fall within the urban definition of MoPE.

Table 1.2: Rural and Urban Population Projections (in millions)

Year	Rural	Urban	Total
2001-02	19.7	3.5	23.2
2006-07	21.5	4.4	25.9
2011-012	21.0	7.6	28.6
2016-017	22.4	8.9	31.3
2021-022	23.8	10.4	34.2
2026-027	25.8	12.0	37.7

Source: WECS, based on MoPE projection for total population.

1.3 Economic Setting

Agriculture is the main source of livelihood for a majority of the population of Nepal. More than 80% of the population is engaged in agriculture, which is still the largest sector of the economy, having a share of around 40% of the GDP. It is characterized by a subsistence orientation, low input use and low productivity.

The average agriculture growth rate stood at 2.48% and non-agriculture growth rate at 10.44% between 1994/95 and 2000/01, at current prices. During the same period, electricity, gas and water registered the maximum growth rate of 20.25%, followed by community and social services (18.45%), finance and real estate (13.78%), and transport, communications and storage (12.5%) (NPC /CBS 2001).

In spite of these growth rates, agriculture is still the dominant and largest sector of the economy. Agriculture sector is broad-based; so, any development in this sector will have balanced geographical spread. The water sector development, specifically in irrigation, drinking water and hydropower, is expected to contribute appreciably towards sustainable growth in the agriculture sector, thereby reducing the level of absolute poverty in line with the national goal.

1.4 Country's Water Resources

Nepal has more than 6000 rivers, which provide a dense network of rivers with steep topographic conditions. All the river systems drain from north to south towards the Ganges. The four major river systems, viz the Mahakali, Karnali, Narayani (Gandaki) and Saptakosi, all predate the uplift of the main Himalayan ranges and cut through the mountain ranges to form deep river valleys. The other medium rivers originating from the Mahabharat range are Kankai, Kamala, Bagmati, West Rapti and Babai. The southern rivers rising from the Siwalik range have little water during dry season, but they cause flash floods during monsoon. The total average annual runoff from all these river systems is estimated at about 225 billion cubic metres (BCM). The surface water estimate varies according to the period of data used. The estimates are based on available data of certain stations up to the year 1995.

1.4.1 Surface Water Resources

The major river systems of Nepal, which originate in the Himalayas are Koshi, Narayani (Gandaki), Karnali and Mahakali.

The Koshi river basin is the largest river basin in Nepal. It covers a total catchment area of 60,400 sq km, out of which 46%, or 27,863 sq km, lies in Nepal and the remaining in Tibet, China. The three main tributaries of the Koshi River are Sunkoshi, Arun and Tamur. The average runoff (discharge) of Koshi is around 1,409 cubic metres per second, equivalent to around 45 billion cubic metres per annum, at Chatara.

The Narayani river basin has a total catchment area of 34,960 sq km and close to 90% of the catchment lies in Nepalese territory. The major tributaries are the Trishuli, Budhi Gandaki, Marsyangdi, Seti and Kaligandaki. The average runoff (discharge) of Narayani at Narayangadh is around 1,600 cubic metres per second (m3/sec) (equivalent to around 50 BCM per annum).

The Karnali River at Chisapani has a total catchment area of 43,679 sq km. Karnali originates in the south of the Mansarovar and Rokas lakes in Tibet, China. Ninety-four per cent of the catchment area lies in Nepal. The main tributaries of Karnali are West Seti, Bheri, Humla Karnali, Mugu, Karnali, Singa Tila, Lohare and Thuli Gad. The average runoff at Chisapani is 1,397 m3/sec, equivalent to around 44 BCM per annum.

The Mahakali River is a border river in most of its reaches, and forms the western border between Nepal and India. This river originates in Api Himal. The total catchment of the Mahakali basin is 15,260 sq km. Thirty-four per cent of the catchment area lies in Nepal.

There are five medium river basins, viz Kankai, Kamala, Bagmati, West Rapti and Babai. Each of these medium rivers are primary and rain-fed, and originate in the Mahabharat Range. These rivers are also perennial, with groundwater and springs sustaining the river-flow during the dry period. The total catchment area of these rivers inside Nepalese territory is computed at around 17,000 sq km, while the average combined runoff (at various gauging stations) is estimated at 461 cubic metres per second, equivalent to around 14.5 BCM per annum.

The so-called southern rivers, sometimes called Siwalik rivers, originate in the Siwalik hills. These rivers are shallow in depth and mostly dry up during the dry season. The major ones among them number seventy-three and are grouped into eight groups, each between a basin

covered by large and medium rivers. The total catchment area of these rivers is estimated at 23,150 sq km, while the average combined runoff is estimated at 1,682 cubic meter per second, equivalent to 53 BCM per annum. These rivers are used by small-scale farmer-managed irrigation schemes (FMISs) for seasonal supplementary irrigation.

1.4.2 Groundwater Resources

The hydro-geological mapping indicates that the terai has a tremendous potential of groundwater resources. The terai, with a thick sequence of saturated detrital sediments of alluvial and colluvial origin, is one of the most productive aquifers in the subcontinent.

The erosion of the Siwalik Hills and the outwash fans of rivers form the northern-most Bhabar Zone. The aquifers are unconfined and sediments being of coarse materials have very high permeability in the range of 100-150 metre per day (m/d). The Bhabar Zone is considered to be the main source of recharge for the terai groundwater.

Groundwater recharge at specific area is estimated to be as high as 600 mm per annum; however, it is assumed that overall 450 mm is a recoverable recharge figure for all of the terai area. Inner terai areas such as Chitwan, Dang and Surkhet are also estimated to hold good groundwater potential. It is, thus, estimated that rechargeable groundwater in the terai is anywhere between 5.8 BCM and 11.5 BCM.

At present, it is estimated that about 756 million cubic metres (MCM) of groundwater resources are being used for irrigation purposes and 297 MCM for domestic uses. Hence, there is huge potential of groundwater use in the form of shallow tubewells (STWs) and deep tubewells (DTWs) for different uses in the terai areas.

1.5 Existing Water Use Scenario

Although Nepal has 225 BCM of water available annually, only a small part of it (estimated at 15 BCM) has so far been utilized for economic and social purposes. Until now, Nepal has utilized mainly medium and small rivers for different uses such as drinking water, irrigation and hydropower. The larger and perennial Himalayan rivers, except for a few run-of-the-river schemes, have been virtually left untapped. Since there is extreme seasonal variation in water availability in the Nepalese rivers, all future programmes will have to focus on storage of water during the rainy season and its utilization during dry periods.

Only 72% of the country's population has access to basic water supply at present. Most of the completed urban water supply systems are not delivering water satisfactorily. In the rural areas, the government policy has been to hand over management of the Department of Water Supply and Sewerage (DWSS)-built systems to the communities concerned. Many completed rural water schemes are not functioning properly. So, the government is currently planning to rehabilitate and upgrade more than 500 such schemes and hand them over to the communities concerned for operation and maintenance (O&M).

Sanitation sector is lagging far behind in Nepal. Even the few completed sewerage systems are not functioning satisfactorily. Only 25% of the whole population has sanitation facility. At present, water supply and sanitation programmes have been tied up together, as a

result of which things are gradually improving in the sanitation sector. Public health education programmes are also being integrated with the drinking water and sanitation programmes.

Nepal has 2.64 million hectares (ha) of cultivable land and 66% of this land, ie 1.76 million ha, is irrigable. Around 60% of the irrigable land has some kind of irrigation facility, and less than one-third has round-the-year irrigation. Agriculture production was 7.2 million tons in 2003, which just meets the minimum requirement of the nation's edible grains. Out of this, only 3.3 million tons were from the irrigated agriculture.

Expansion of irrigated agriculture is essential for meeting the food security requirement of the country. Many feasible surface irrigation projects have already been taken up and a few are awaiting implementation. Most of the remaining irrigable land in the terai can be effectively irrigated by groundwater utilization. Tubewell irrigation by treadle pumps, STWs or even by DTWs are much cheaper to develop than surface irrigation schemes, although the direct cost of O&M is higher for tubewells at present. The cost of production of cereal crops such as paddy and wheat requires to be made competitive with the Indian products because of the open border with India.

More than 70% of the country's irrigated area falls under FMISs. In the remaining areas, some systems are being transferred wholly to the water users associations (WUAs) concerned for management, whereas some are being jointly managed by the government and WUAs. Community-managed systems are found to be more efficiently managed than government-managed systems. However, the possibility of the government playing a crucial role in research and development, extension services and other regulatory fiscal and non-fiscal mechanisms cannot be ruled out. At the same time, essential and emergency assistance from the government to the communities in the rehabilitation and repair of irrigation systems has to be continued to sustain the farmer-managed or management transferred systems.

Communities and private sector institutions are also actively engaged in developing renewable energy resources, including hydropower, in Nepal. At present, electricity generated from various systems supply power to 40% of the households in the country. The share of power supply from the community or private sector-owned systems is 17%. In Nepal, hydropower schemes of up to 1 megawatt (MW) does not require any licence for development and also do not have to pay any income tax on the revenue generated from such schemes. Those schemes, however, need to be registered with the district administration office concerned. This government policy has greatly helped proliferate decentralized small and micro hydropower systems in the hilly and mountain districts of Nepal. In recent years, such micro hydro projects have helped to meet the community's minimum electricity need for lighting purpose, thus contributing substantially to improving the quality and standard of living in the remote areas of the country.

The Integrated Nepal Power System (INPS) is primarily managed by a parastatal organization, Nepal Electricity Authority (NEA). At present, NEA has a total installed electricity generation capacity of about 619 MW, of which the hydropower capacity is 562 MW. At present, the 70 MW Middle Marsyangdi Hydro Project is under construction, which is expected to be commissioned in 2006. Several small hydropower schemes, with a combined capacity of about 30 MW, with which NEA has entered into power purchase agreement (PPA), are being developed by various private sector entities. It has been demonstrated that the country possesses

an in-country capacity for developing medium-sized hydropower projects with a power generation capacity of up to 50 MW. It has also been demonstrated that domestically-developed schemes are highly cost effective and could easily compete with the costs of production in the South Asia region. Nepal must strive for creating a more conducive environment to accelerate the development of in-country capacity, as well as encourage investments in the hydropower sector.

Nepal must encourage extensive rural electrification, particularly in the terai, where micro hydro schemes are not possible. Electrification in the rural terai has the additional economic benefit for the power sector because it will also open up a huge consumer base that will use the country's surplus power, if any. At the same time, promotion of electricity-intensive industries can further encourage hydropower generation, while value-added industrial products from such industries become competitive in the regional and global markets at the same time. In the current scenario, large-scale hydropower projects are feasible in Nepal only when India is prepared to buy power at commercial rates and to share the benefits accrued by way of downstream benefits in case of storage dam projects.

The high dam projects identified, which store large volumes of monsoon flood and generate huge hydroelectric power, will essentially have regional ramifications. The bone of contention in these projects seems to be the Indian viewpoint that sees such projects as strictly bilateral issues and undermines the issue of downstream benefits in terms of irrigation as well as flood. It is yet to be seen how India intends to address the issue of cost sharing regarding the proposed 'river-linking project', which eventually will involve building storage dams in Nepal.

Use of rivers for cultural and recreational purposes is also important for Nepal. While water rafting is getting popular among adventure-seeking tourists as well as local youth, cultural and religious uses are spiritually and environmentally sensitive. The potential of river sports as well as aquatic culture is not fully realized, and therefore needs to be explored in the future.

2. Planning Context

2.1 Planning Efforts in the Past

Nepal embarked upon a planned process of development in 1956, shortly after the advent of democracy. The periodic national development plan process has been continuing since then and a national plan document normally has a life of five years. The current national plan is the tenth in the series and covers the period 2002-2007. The country has attempted several approaches and concepts during its various periodic plans such as integrated rural development, decentralized planning, regional development, sustainable development and poverty alleviation approaches. The National Planning Commission (NPC), in its various incarnations, has been in place since the advent of democracy in 1951. The NPC is responsible for preparing and monitoring the national development plans. The planning process of Nepal, by and large, is oriented towards the top-down approaches, though attempts have been made to orient it towards the bottom-up approaches in the recent past.

Similarly, Nepal has had experience in the preparation and implementation of other sectoral plans such as the Agriculture Perspective Plan (APP), Forestry Master Plan, Irrigation Master Plan, River Basin Master Plans, Tourism Master Plan and other sectoral perspective plans. However, development issues started getting more and more complex over the last two decades

as development paradigms shifted towards human, societal and environmental development aspects from the traditional economic and infrastructural growth models. Governance issues became more pronounced as demands for popular participation grew. The water sector had to gear up to address these contemporary issues.

2.2 Rationale for Water Plan

For the past several decades, it has been surmised that water is one of the principal natural resources supporting the economy of Nepal which can be utilized to catapult the socioeconomic status of the people of the country. In spite of the efforts made to develop the resources through the implementation of the periodic plans and sectoral plans and external assistance, water resources development has been slow and so far unable to contribute much towards the alleviation of poverty among the masses. Hence, the need for a focused strategy and a comprehensive national water plan.

Against the past planning backdrop, Nepal had to start thinking afresh in the development of its water resources. The strategic thinking started in 1996. A Water Resources Strategy (WRS) was developed. Hence, this National Water Plan (NWP) is prepared to encompass programmes in all strategically-identified output activities so that tangible benefits can be delivered to all the people in line with the basic needs. Specifically, the NWP is developed to operationalize the output objectives of the WRS, as approved in January 2002. The Water & Energy Commission Secretariat (WECS) has been made responsible for developing a water sector strategy and the NWP, as it is designated as the central water planning institution.

2.3 Need for Integrated Water Resources Management (IWRM) and River Basin Management (RBM)

Traditional water resources management was focused on the supply side where only technical solutions were considered to meet the growing demand for water. Isolated projects on irrigation, drinking water supply and sanitation, hydropower, flood control and other uses were developed. Evaluation was mainly based on economic criteria and environment and social impact was not fully considered. Independent sector authorities mostly controlled these projects on the basis of command and control. The results, so far, have not been satisfactory, resulting in inter-sectoral, inter-regional and riparian conflicts. Optimum utilization of water for the benefit of all stakeholders in the particular river basin couldn't be achieved in terms of efficiency, equity and environmental considerations.

The integrated water resources management (IWRM) principle professes that water must be viewed from a holistic perspective, both in its natural state and in balancing the competing demands on it, eg domestic, agriculture, hydropower, industrial, cultural and environmental. Management of water resources services needs to reflect the interactions between various demands, and so must be coordinated within and across the sectors. More equitable, efficient and sustainable regime will emerge, provided crosscutting requisites are met, along with horizontal and vertical integration within the management framework of the water resources and services.

The IWRM is defined as a process that promotes the coordinated development and management of water, land and related resources to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems.

The formulation of the WRS is based on certain identified policy principles involving the IWRM. Two of the stated policy principles relevant to river basin management (RBM) are:

(a) Development and management of water resources shall be undertaken in a holistic and systematic manner, relying on the IWRM.
(b) Water utilization shall be sustainable to ensure conservation of resources and protection of the environment. Each river basin system shall be managed holistically.

River Basin Management

The rationale of undertaking water resources on a basin scale, instead of on a project to project basis, is because water and land resources of a river basin are interrelated and form a unit as such. They must be treated as a fundamental planning entity. Because of many development options available, potential existence of water use conflicts and trade-offs, and inherent interdependence among water, soil and land use, river basin planning and management is a complex task. Therefore, it is essential to include as many stakeholders as possible in the deliberations and decision-making processes.

A river basin encompasses the drainage area upstream from the mouth of the main stream of the area, and is defined by outlining the drainage divide between this and adjacent basins on a suitable topographic map. The geological structure sometimes indicates an underground water system with somewhat different boundaries other than shown on the topographical map, eg in the terai or southern river catchments (basins).

Water use and management is a complex task, involving various sectors and a multitude of stakeholders. One of the challenging tasks of the NWP is the integration of all crosscutting sectors as well as individual water-related traditional subsectors. The IWRM, though complex, has now been universally accepted as a tool to manage the task related to sustainable water resources development.

In order to implement the IWRM principles, certain structures are needed to be in place. These are as follows:

- The enabling environment: Formulation and implementation of appropriate water policies and legislation to encourage and regulate the private sector and communities, ensure separation of regulating and service provision functions in line with the IWRM principles;
- Institutional framework: Provision of defined institutional roles to central- and local-level government institutions in relation to river basin management, including the relations between government and nongovernmental organizations (NGOs) and private sector in consultation, coordination and participation of all stakeholders;
- Management instruments: Development of decision support systems (DSS)/tools for various management decisions such as regarding water resources assessment, water allocation and conflict resolution.

2.4 Consultation Process Adopted for NWP

The policy principles of the water sector emphatically declares that participation of, and consultation with, all stakeholders shall constitute the basis of water sector development.

Keeping in view this principle, as well as the positive experience during the strategy preparation and having faith in the stakeholder consultation process, the NWP preparation process was designed to involve as many stakeholders as possible at different levels and from varied professional and civil society sectors, including politicians and user groups. The process of consultation was pursued at different stages of the NWP sub-sector programme preparation, culminating in broad-based regional and national workshops.

Preparation of the NWP followed immediately after the approval of the WRS. A draft NWP was formulated by the WECS core group with the assistance of five functional taskforces supported by individual consultants. The sub-sector reports were presented and discussed not only with the taskforce members but were also presented and discussed with small focus groups during separate interaction programmes. The sub-sector plan reports were synthesized into a draft NWP by the water resources advisor and discussed in-house at WECS with all professionals, including executive directors and secretaries, at different stages.

The draft NWP was then presented to the stakeholders at regional workshops held in Nepalgunj, Biratnagar and Pokhara in early 2004. At those regional workshops, several consensus programmes on raising domestic investment funds and establishment of district water resources assembly were agreed upon. The draft Plan was further refined at a national workshop, which were followed by internal workshops, involving various government officials and freelance experts.

Sub-sector water plans have been developed. All these programmes, if effectively implemented, will help to achieve the objectives of the national water sector goal. Detailed programmes and project portfolios are given in the annexes of this report.

3. Water Sector Objectives and Policy Framework

The WRS formulation process originates from a clear and comprehensive policy framework. With key stakeholder input, WECS has developed and adopted a set of objectives and policy principles that provide a framework for the formulation of a strategy. The proposed policy framework, which has been endorsed by HMG as an integral part of the Strategy, consists of a set of water sector objectives, core policy principles and other development objectives.

3.1 Water Sector Objectives

Water resources development, like any other national development, should aim to contribute to improving the quality of life. Specific objectives adopted for the formulation of the WRS include:

- To help reduce the incidence of poverty, unemployment and under-employment;
- To provide people with access to safe and adequate drinking water and sanitation for ensuring health security;
- To increase agricultural production and productivity, ensuring food security of the nation;
- To generate hydropower to satisfy national energy requirements and to allow export of surplus energy;
- To supply the needs of the industrial and other sectors of the economy;
- To facilitate water transport, particularly connection to a sea port;
- To protect the environment and conserve the biodiversity of natural habitat; and
- To prevent and mitigate water-induced disasters.

3.2 Policy Principles for Water Sector

Policy principles♥ that are being used to guide Nepal's water sector in the development of the WRS include:

- Development and management of water resources shall be undertaken in a holistic and systematic manner, relying on the IWRM.
- Water utilization shall be sustainable to ensure the conservation of the resource and protection of the environment. Each river basin system shall be managed holistically.
- Delivery of water services shall be decentralized in a manner that involves autonomous and accountable agencies (eg public, private, community and user-based agencies).
- Economic efficiency and social equity shall guide water resource development and management.
- Participation of and consultation with all stakeholders shall constitute the basis of water sector development.
- Sharing of water resources benefits among the riparian countries shall be on equitable basis for mutual benefit.
- Institutional and legal frameworks for coordination and transparency shall be an essential feature of water sector management.
- Wider adoption of the best existing technologies and practices, as well as rapid innovation and adaptation of both institutional arrangements and new technologies, shall be ensured.

3.3 Other Guiding Principles for Strategy Formulation

There is recognition in Nepal that water resources development needs to be more closely integrated with sustainable social and economic development. Therefore, in addition to the policy principles for water sector development and management described above, some general principles (ie evaluation guidelines) have been established to contribute to the following national objectives:

- Social development
- Economic development, and
- Environmental sustainability.

Principles or guidelines are essential to the formulation of the WRS because the Strategy's ultimate goal includes each of these objectives. The goal of the WRS is to significantly contribute towards the improvement of the living conditions of Nepalese people in a sustainable manner. The following principles help to further define and provide policy guidance for this statement within the water sector.

3.3.1 Social Development Principles

- People affected by a project should be encouraged to participate or take ownership, as appropriate.
- Water sector development should directly contribute to improved health and living conditions.
- Water sector development should ensure long-term food security.

♥ These Principles have been developed for Nepal, but there is close similarity with the principles adopted by the World Water Forum

- Socially and economically disadvantaged/vulnerable groups (e.g. poor, disabled) should be considered for targeted assistance to ensure that they benefit significantly from projects.
- There should be more gender-balanced participation.
- Appropriate technology that is affordable, manageable and cost-effective and which will generate local employment opportunities should be emphasized.
- Water resources projects should be integrated with social development, wherever possible.
- Water resources development should strive for equitable balance between rural and urban areas (ie rural areas should be provided better opportunities for employment and improved living conditions).
- The common property resource system should be maintained and enhanced, or if affected, adequately restored.
- People should be aware and be responsible towards managing water efficiently, conserving water, preserving/protecting water sources from degradation and maintaining water quality.
- All people who are adversely affected by water resources projects should be made better off following the implementation of the project.
- Project-induced resettlement should be avoided or minimized. If resettlement is required, adequate and timely compensation and rehabilitation measures should be provided to fully offset social and economic losses and to enable those affected to share the overall benefits of the project.

3.3.2 Economic Development Principles

- Water resources development should contribute significantly to national economic output.
- Water resources development should address poverty alleviation and employment generation.
- Hydropower development should satisfy the domestic needs for electricity and an increasing share of national energy requirements, as well as generate export earnings for Nepal.
- Irrigation development should be one of the main components for increasing food production.
- The cost of drinking water supply and sanitation systems should eventually be borne by the users themselves.
- The economic benefits of water resources development should be shared equitably by region and by income group.
- The cost of water pollution should be borne by the polluters.
- Private sector investment and/or participation should be promoted to provide an increasing share of the required capital and operational capacity in the water sector.

3.3.3 Environmental Sustainability: Definitions and Principles

Relevant sustainability definitions include:

- Sustainable development protects conserve and manage natural resources and ecosystems while orienting technological, economic and institutional changes to meet the needs of the present and future generations.
- Sustainable growth requires that the rate of consumption of natural resources does not exceed the rate of their regeneration.
- Sustainable water resources exist when their management and development include consideration of all aspects of the water cycle and all uses by society, and maintain the integrity, ecological structure and functions of watersheds.

3.4 The Water Strategy: Salient Features

Nepal formulated the Water Sector Strategy (WSS) to guide water sector activities towards sustainability of the resource, while providing economic growth through water resources development, hazard mitigation, environment protection and constructive methods of resolving water use conflicts.

The national water sector goal has been defined as 'living conditions of Nepali people are significantly improved in a sustainable manner.' The WRS output is expected to contribute to the attainment of this goal through the achievement of short-, medium- and long-term purposes. These purposes have been defined as follows:

- **Short-term (5-year) Purpose:** The implementation of the comprehensive WRS provides tangible benefits for people in line with basic needs fulfilment.
- **Medium-term (15-year) Purpose:** WRS is operationalized to provide substantial benefits for the basic needs fulfilment of the people as well as other increased benefits related to sustainable water use.
- **Long-term (25-year) Purpose:** Benefits from water resources are maximized in Nepal in a sustainable manner.

To achieve these purposes, the WRS has defined ten strategic output, which are categorized under security, use and mechanism aspects, and are listed below:

Security

1. Effective measures to manage and mitigate water-induced disasters are made functional.
2. Sustainable management of watersheds and aquatic ecosystems is achieved.

Use

3. Adequate supply of and access to potable water and sanitation and hygiene awareness is provided.
4. Appropriate and efficient irrigation is made available to support optimal and sustainable use of irrigable land.
5. Cost-effective hydropower is developed in a sustainable manner.
6. Economic uses of water by industries and water bodies by tourism, fisheries and navigation are optimized.

Mechanisms

7. Enhanced water-related information systems are made functional.
8. Appropriate legal frameworks are made functional.
9. Regional cooperation for substantial mutual benefits is achieved.
10. Appropriate institutional mechanisms for water sector management are made functional.

Each output requires successful implementation of a set of activities encompassing physical, managerial, economic and institutional aspects. Together, these output will advance the long-term purpose of the WRS to maximize benefits through sustainable management of the resource, and in doing so, will significantly contribute to the improvement of the living conditions of the Nepalese. Table 3.1 summarizes the strategic goal, purposes and output developed for short-, medium- and long-term timeframes.

Table 3.1: Summary of Strategy Output

GOAL			**Living condition of Nepalese people significantly improved in a sustainable manner**		
TIMEFRAME			**5-year Strategy**	**15-year Strategy**	**25-year Strategy**
PURPOSE			The comprehensive WRS implementation found providing tangible benefits to people in line with basic needs fulfilment, supported and managed by capable institutions of all stakeholders	WRS operationalized to provide substantial benefits to people for basic needs fulfilment as well as other benefits supported and managed by capable institutions of all stakeholders	Sustainable benefits of water use to Nepal maximized
OUTPUT	**SECURITY**	1. Disaster Management	Institutional capabilities enhanced to manage water induced disasters	Effective measure adopted to manage water related disasters and mitigate their adverse effect	Effective water-induced disasters management systems are functional
		2. Environment	Institution strengthened for watershed and ecosystem protection / management	Full scale watershed / aquatic ecosystem activities implemented	Watersheds and aquatic ecosystems managed in a sustainable manner
	USERS	3. Water Supply	Access to water supply and sanitation expanded / enhanced	With increasing sanitation and drinking water coverage, service level and quality improved	Adequate supply of and access to quality potable water, sanitation and hygiene awareness provided for all
		4. Irrigation	Irrigation systems planned, developed and continued for sustainable management	Reliable irrigation service expanded on the basis of sustainability and wealth creation	Appropriate and efficient irrigation available for the optimal use of irrigable land in a sustainable manner
		5. Hydropower	Hydropower developed for domestic needs and viable export	Hydropower development maximized for different uses (including energy-intensive industries and export of power) providing substantial benefits	Hydropower optimally developed
		6. Other Economic Activities	Economic activities for fisheries, aquaculture, recreation, tourism, navigation and industrial water uses implemented	Economic uses of water and water bodies by recreation, tourism, fisheries, aquaculture, navigation and industries enhanced	Economic uses of water d water bodies by creation, tourism, fisheries, uaculture, navigation and dustries optimized
	MECHANISMS	7. Information Systems	Functional water-related information and dissemination system strengthened / established	Water-related information/dissemination system functioning	Water-related information system enhanced
		8. Policy & Legal	Appropriate policy and legal frameworks, including equitable water use rights, established	Adequate legal framework functioning	Adequate legal framework functioning and adopting to changing circumstances
		9. International Cooperation	Regional / bilateral cooperation framework / norms operationalized	Effective mechanism for regional/ bilateral cooperation function	Regional / bilateral cooperation for substantial mutual benefits achieved
		10. Institutional Mechanisms	Appropriate institutions established / activated	Institutional mechanism for integrated water management functioning	All Institutions functioning efficiently in tune with changing circumstances

Note: The long-term WRS envisions a continuous process with some thresholds in between. Broadly speaking, the five-year strategy is oriented towards the fulfilment of the basic needs of people, the fifteen-year strategy is for consolidation of sub-sector programmes for maximization of these benefits and the twenty-five-year strategy is for their optimization.

Part B. The National Water Plan

4. The National Water Plan

The National Water Plan (NWP) has been prepared to operationalize the Water Reources Strategy (WRS) of Nepal, approved by the HMGN in January 2002. The NWP includes programmes in all strategically identified output activities so that all these programmes, in consonance with each other, will contribute to maximizing the sustainable benefits of water use.

The broad objective of the NWP is to contribute in a balanced manner to the overall national goals of economic development, poverty alleviation, food security, public health and safety, decent standards of living for the people and protection of the natural environment.

The NWP is a framework to guide, in an integrated and comprehensive manner, all stakeholders for developing and managing water resources and water services. The NWP has developed a set of specific short-, medium- and long-term action plans for the water sector, including programme and project activities, investments and institutional aspects.

4.1 Doctrines of NWP

The major doctrines of the NWP are integration, coordination, decentralization, popular participation and implementation of water-related programmes within the framework of good governance, equitable distribution and sustainable development.

Integration

Integration, among other aspects, aims to achieve: (a) efficiency and effectiveness of water management by empowering and entitling users; (b) recognition of essential interconnectedness of users in terms of water use and allocation within river basins; (c) widespread support from users and the public for the priorities and management decisions which are established; and (d) competent data collection, preservation and analysis to evaluate major prospective development and diversions.

Integration seeks to avoid: (a) hardships from water shortages, flooding and impaired quality; (b) acrimonious conflicts and disputes over water allocation and management; (c) irresponsible, ineffective, unjust, or unwise water allocation and unsound management decisions on development; and (d) creation of large new crosscutting administrative and regulatory organizational structures.

Integration of all water-related programmes is, therefore, to be carried out from the lowest level of river basin entities. Water users' groups (WUGs) will be formed (and in some cases, people encouraged to form them) in each of the sub-river basins, based on the needs of the basin. A sub-basin committee, with an appropriate number of members, representing all WUGs, including women groups, nongovernmental organizations (NGOs)/community-based organizations (CBOs), other focus groups or entities and minorities will be democratically elected to function as the executive body for the water management of the sub-basin. Appropriate representation of the village development committee (VDC) concerned will also be made on the sub-basin committee. The function of the sub-basin committee will be, but not limited to, the following:

- Prepare a database of land, water and human resources.
- Deliberate and assess the water needs of different users and groups.
- Develop and implement integrated water resources development programmes in an agreed priority.
- Seek technical and financial assistance from the local NGOs and local government, in addition to external assistance through local government.
- Raise financial resources from within the basin.
- Assist, but not intervene, local WUGs to function effectively.
- Represent the sub-basin in the district water resources committee (DWRC) and district water assembly (DWA).
- Inform and educate the general public in the benefits of integrated water management.

DWRC, administered under the district development committee (DDC) concerned, will be restructured and redefined to include the responsibility of integrated water resources management under its jurisdiction, besides the regulating responsibilities. The committee will include the appropriate sub-basin committee representatives as its members. DDC chairperson will head DWRC. District Technical Office (DTO) will act as its standing secretariat. The functions of the committee will include, inter alia, the related functions enumerated against the sub-basin committee, besides other regulating and facilitating functions. Subject matter specialists will be called in to support the decision-making process. If a river basin falls in two or more districts, an inter-district DWRC basin committee will be formed. Similarly, at the centre, at WEC, major river basin authorities will be constituted as per the need and demand. The functions of the authority will be, but not limited to:

- Collect, collate and create databases of land, water and human resources.
- Develop and implement policies towards the IWRM.
- Develop guidelines, procedures and manuals for the IWRM.
- Provide advice and support to river basin entities at all levels.
- Act as an adjudicator when a conflict arises.

A DWA shall be formed in each district, initially in districts where imminent water allocation problems exist, as an apex district body to conserve, manage and develop the water resources of the district. It will include representative members of sub-basin committees as well as stakeholder members from all walks of life in the district. It will elect a chair from among its members through a democratic election process. An integrated river basin water management schematic diagram is presented in Fig. 4.1.

Coordination

Water resources management is a complex issue involving many different agencies. Water management includes development, as well as conservation, and many more aspects and sectoral interests; hence, management responsibilities overlap and in some cases conflict with each other. Most water management is carried out by agencies that have sectoral mandate such as irrigation, hydropower, drinking water, industrial water supply or environmental protection.

Coordination is the centrepiece of management functions. Responsibilities, duties and rights should be clearly stated, understood and obeyed by all parties to avoid unnecessary conflicts and misunderstandings.

Hence, it has been envisaged to designate WEC as a single neutral coordinator and administrator at the central level responsible for integrated national water planning, policy analysis and development, in addition to development of appropriate legislation and mechanisms for other broad water management functions and practices, including central-level programme fixation and resource allocation.

Similarly, DWRC will be made responsible for coordinating the activities and programmes at the district level. Coordination is seen as a top-down approach. If it can be achieved at higher or central level, it is much easier to achieve coordination at different lower tiers of management.

Decentralization

It has become evident that efficient delivery of water services can be achieved through decentralized management. Decentralization of authority and responsibilities should be carefully delegated to appropriate level(s). The important sequence of decentralization is a clear setting up of duties, responsibilities and rights for each level to avoid unnecessary overlaps. Generally, anything related to water utilization and operation is to be the responsibility of local government unit or locally constituted institutions, involving all related stakeholders. Empowerment and capacity building of local institutions are the keys to decentralization.

This arrangement will have many advantages; for instance, local institutions will be promoted to grow and stand on their own; services to the beneficiaries will be improved; and water resources development and management will be more efficient. In view of the increasing conflicts over water use and effects of pollution, local-level institutions will be effective in dealing with such matters. However, inconsistencies in the provisions of different Acts and regulations, viz the Local Self-Governance Act (LSGA), Irrigation Rules, Water Supply Rules and Electricity Act and Rules have been noted and, therefore, will be harmonized to make the local institutions effective and functional.

Popular Participation

Water resources development and management involves multiple sectors, including religious and cultural aspects, and impacts them in several ways. A participatory approach, involving users, planners and policymakers at every level is imperative. The NWP makes it mandatory to involve popular participation in all its decision-making processes.

The participatory approach not only raises the awareness of the importance of water among all stakeholders, but also helps in the attainment of the optimum use of the water resources, as well as building consensus on overall development. It also helps in fostering community ownership of development activities, which, in turn, ensures sustained development. The formation of users group in each sub-sector activity and sub-basin committee(s), which is one of the key components of the NWP, will ensure popular participation in the integrated water resources development and management in the country.

Equity

Equity, women participation and social inclusion are some of key elements of the country's commitment to shared growth. Equity enhancing policies not only enthuse stakeholders

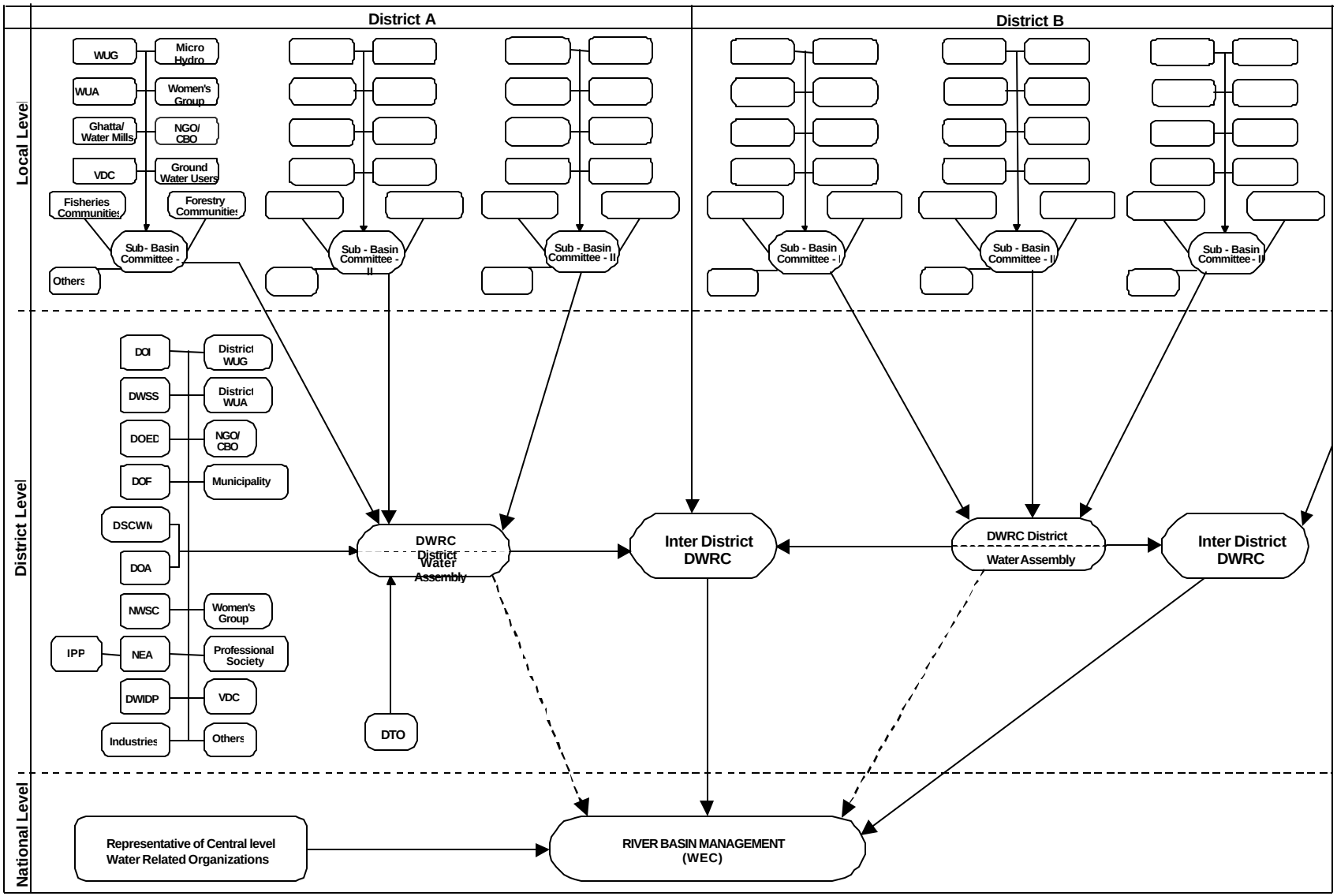

Fig. 4.1 Integrated River Basin Water Management, Schematic Diagram

towards popular participation in decision-making process, but also instils in them confidence in the governance system.

The HDI varies tremendously within the country, for instance the HDI for the districts of Mugu, Kalikot and Dolpa is respectively 0.147, 0.177 and 0.218, whereas for Morang, Lalitpur and Kathmandu districts, it is 0.421, 0.523 and 0.603, with a country average of 0.504.

In this context, the NWP seeks to remedy the imbalances by proposing social programmes to mitigate the expected negative impact in the existing and ongoing programmes and emphasizes expansion of water resources development programmes in the districts with lower HDI.

The NWP will also give adequate attention to creating employment opportunities, especially for the deprived ethnic groups, during programme implementation. Overall human resources development will be made a part and parcel of the NWP, as the success of the NWP hinges heavily on the availability and proper utilization of the country's human resources.

A guiding principle matrix of NWP implementation has been prepared and presented in Table 4.1. The matrix is expected to encourage the implementing agencies to adhere to the doctrinal policy of the NWP and, at the same time, provide a monitoring tool for the supervising and planning agencies.

Table 4.1: Guiding Principle Matrix of NWP Implementation

Core Programmes	Integration	Decentralization	Coordination & Management	Stakeholder Participation	Equity, Gender & Social inclusion
Water-induced Disaster					
Watershed Management					
Drinking Water & Sanitation					
Irrigation for Agriculture					
Hydropower					
Other Economic Uses					

Good Governance

Governance in Nepal continues to be a persisting problem, resulting in inefficiency in service delivery and utilization of public resources. Lack of transparency, accountability and predictability has been a distinctive feature of the governance system in Nepal. These anomalies need to be corrected as a matter of urgency. Systems that improve the efficiency and accountability of civil servants as well as those of elected officials in public offices need to be in place to enhance the credibility of the governance system. Without a good governance system, it will be naïve to expect to fully achieve the expected output of the NWP, in which the State is expected to play a decisive role.

The following sub-sector water plans, all together in consonance, will help achieve the objectives of the NWP, primarily if all the enabling environment, including institutional and legal mechanisms, are in place and the project activities therein are internalized by the NPC.

4.2 Sub-Sectoral Programmes

The sub-sector programmes have been presented below under the security, use and mechanism aspects.

4.2.1 Security Aspects

4.2.1.1 Water Induced Disasters

Current Status

Nepal is highly vulnerable to recurrent floods and landslides. The Nepal Himalayas comprise a geologically active zone where instability due to tectonic activity and ongoing erosion is everywhere apparent. These factors, combined with peculiar meteorological conditions where the rainfall and river flow vary tremendously in both time and space, make the landscape vulnerable to water-induced disasters such as floods, landslides, slope failures and debris flow.

In addition to these natural processes, development activities and increasing population have caused further vulnerability and destabilization of land resources. This continuous human-induced vulnerability stems from activities such as deforestation, cultivation of marginal land, road building in hills and mountains, and encroachment of flood plains. The water-induced disasters, thus, have been occurring more frequently in recent times.

Statistics indicate that 6,025 people have lost their lives in floods and landslides between 1983 and 2001. The estimated economic losses from these calamities amounted to around NRs11,860 million.

The Department of Water-Induced Disaster Prevention (DWIDP) was established in February 2000 and is organized at both central and district levels. The DWIDP has been made responsible for managing and mitigating water-induced disasters. At present, the Natural Disaster Relief Act (NDRA) 1982 and the Local Self-Governance Act 1999 primarily provide the legislative framework for disaster management. DWIDP has been designated as the lead agency for water-induced disaster (WID) management.

Targets

- by 2007 potential disaster zones are identified by type and located on district maps.
- by 2007 emergency relief materials are available in all five regions.
- by 2017 infrastructures for mitigating predictable disasters are put in place in twenty districts.
- by 2017 warning systems are established and made functional. encompassing the whole country.
- by 2027 social and economic losses due to water-induced disaster are reduced to the levels experienced in other developed countries.

Action Programmes

The focus of the WID management during the first five years of the plan is to enhance institutional capabilities for managing water-induced disasters. In the following ten years, effective measures will be adopted to better manage water-induced disasters and mitigate their adverse effects. The long-term goal of the Plan is to make Nepal's WID management system fully functional, effective and responsive to people's needs. The total programme is expected to directly address the needs of the poor and marginalized people, thereby contributing to improved living conditions for the poorest sectors of the Nepalese population.

Seven programmes have been identified for being carried out. The programmes and their key elements are enumerated below:

1. Water-related Disaster Management Policy and Programme: The key elements are:
   (a) Formulation of a WID mitigation policy with reference to upstream, downstream linkages and the International Day for Natural Disaster Reduction (IDNDR) national action plans;
   (b) Preparation of WID-related Acts, Regulations and management guidelines;
   (c) Enhancing the capacity of all WID-related institutions such as the MoHA (Ministry of Home Affairs), MoPE, DWIDP, DHM (Department of Hydrology and Meteorology), DSCWM (Department of Soil Conservation and Watershed Management).

2. Risk/Vulnerability Mapping and Zoning Programme: The key programme elements are:
   (a) Preparation of water-induced hazard maps;
   (b) Identification of critical areas by ground inspection on priority basis; and
   (c) Zoning of high-risk areas.

3. Disaster Networking and Information System Improvement Programme: The key elements are:
   (a) Establishment and activation of disaster forecasting and early warning systems, covering floods, extreme precipitation and drought;
   (b) Strengthening of CBOs, NGOs, INGOs, local authorities, professional societies for disaster management networking;
   (c) Promotion of regional and international cooperation in WID management:
      (i) Establishment and enhancement in cooperation with neighbouring countries in data exchange and information system;
      (ii) Encouragement of joint investigation into the Glacial Lake Outburst Flood (GLOF) with China;
      (iii) Promotion of international cooperation for flood forecasting and warning system.

4. Community-level disaster preparedness programme: The key programme elements are:
   (a) Establishment of emergency supply warehouses for high-risk areas on central and regional basis;
   (b) Development and review of evacuation plans at regular interval, conducting of rehearsals/drills exercises with all key stakeholders at frequent intervals at different locations and providing training in rescue operations for identified groups;
   (c) Formation of standing committees to support search and rescue programme with necessary facilities at district as well as local level (vulnerable localities); and
   (d) Discouraging and restricting settlements in high-risk areas.

5. Relief and Rehabilitation Measures: This activity is normally carried out by the MoHA in close coordination with the Nepal Red Cross Society, Royal Nepal Army

and local NGOs. DWIDP, as the lead coordinating agency for WID, will be involved in planning activities. The key elements are:

(a) Making preparations for emergency response, rescue and relief;
(b) Making arrangements and delivering disaster relief supplies;
(c) Identification and assignment of responsibilities to different organizations for handling relief and rehabilitation work;
(d) Planning for emergency shelter and feeding for victims; and
(e) Securing relief and rehabilitation funding.

6. Activation of Inundation Committee: The key elements are:
   (a) Strengthening the existing bilateral inundation-related committees;
   (b) Formulation of inundation policies; and
   (c) Enhancing exchange of data and information and promotion of formal as well as informal contacts at field level.

7. Flood, Drought, Landslides/Debris Flow, GLOF and Avalanche Mitigation Programme: The key elements are:
   (a) Identification, prioritization and development of management plans for high-risk areas;
   (b) Development of effective non-structural measures such as flood forecasting, warning, flood proofing and disaster preparedness;
   (c) Implementation of mitigation measures such as afforestation and bio-engineering with people's participation, involving CBOs/NGOs and women's groups for river bank protection and conservation of critical areas;
   (d) Implementation of structural measures such as river dikes, spurs, check dams, trail improvement and embankment construction with the help of community groups;
   (e) Disaster due to drought:
      (i) Identification of potential drought-prone areas; and
      (ii) Preparation and implementation of a national plan to cope with droughts.

The project portfolio for WID management is presented in Annex 1.

Table 4.2: Estimated Programme Costs for Water Induced Disasters (in NRs millions at 2003/04 price level)

S.N.	Programmes	Short Term	Medium Term		Long Term		NWP Total
		10th Plan	11th Plan	12th Plan	13th Plan	14th Plan	
1	Water-related Disaster Management Policy and Programme	1.6	0.0	0.0	0.0	0.0	1.6
2	Risk/Vulnerability Mapping and Zoning Programme	8.8	13.7	21.4	0.0	0.0	43.8
3	Disaster Networking and Information	38.4	306.9	624.7	366.1	356.2	1692.2
4	Disaster Preparedness Plans	0.0	15.3	0.0	15.3	0.0	30.7
5	Relief/Rehabilitation Measures	137.0	274.0	274.0	274.0	274.0	1233.0
6	Inundation Committee Activation	2.7	8.2	8.2	2.7	2.7	24.7
7	Floods, Drought, Landslide/GLOF Management	4579.1	5480.0	8065.5	5151.2	5140.2	28416.0
8	Watershed Management of Rivers	386.9	493.2	712.4	548.0	249.9	2390.4
9	O&M	109.6	208.2	339.8	274.0	274.0	1205.6
	Total	**5264.1**	**6799.6**	**10045.9**	**6631.3**	**6297.1**	**35038.0**

4.2.1.2 Environmental Action Plan on Management of Watersheds and Aquatic Ecosystems

Current Status

Watersheds and aquatic ecosystems are integral parts of water-based infrastructure development because Nepal can be considered a complex large watershed of numerous watersheds and the water flowing from these watersheds and aquatic ecosystems is used for irrigation and hydropower development. The total watershed of the rivers covers an area of 191,000 km², of which 74% lies within Nepal. Depending upon the source and discharge, they are used for various purposes, ie irrigation, hydropower, drinking and other economic purposes. From this perspective, watersheds and aquatic ecosystems have an indispensable role to play in the sustainable development of these sectors.

The condition of watersheds and aquatic ecosystems has been deteriorating due to the mismanagement and overexploitation of natural resources. In addition, increased interventions due to growing population have induced human-made disasters and accelerated the process of natural disasters. According to an inventory of watershed condition, it is estimated that 7% of the land area, about 10,000 km², is devoid of vegetation, 17% of the land needs immediate conservation attention, and many of the watersheds are in a state of desertification due to physical and biological factors. The district-wise status shows that the most affected are the hilly districts. Similarly, aquatic resources are also in threatened conditions due to encroachment, periodic flash floods, pesticide and chemical pollution, landslides and erosion, water pollution and deforestation. The construction of dams has also affected the normal aquatic life. The declining aquatic drying of wetland and declining aquatic diversity are the major threats to the aquatic ecosystem.

Although efforts are being made to manage the watersheds and aquatic ecosystems, much still needs to be done to fully cope with the problem. Lack of strong institutional mechanisms has hampered programme replication. Similarly, lack of data and mapping has hampered updating of programmes. Focus of water development programmes only on water-based infrastructure has shadowed the environmental concerns, and lack of coordination between water-based infrastructure and watershed management has created a gap in watershed and aquatic ecosystem management at project level. Therefore, environmental action plans on sustainable management of watersheds and aquatic ecosystems have been developed to minimize the environmental problems, fulfill the gaps and maximize the benefits from the environment conservation for the development of the water sector plan.

Targets

The overall environmental targets are as follows:

- by 2007 a management plan for nationally important watershed and aquatic system is prepared and initiated.
- by 2007 water quality and wastewater quality standards are developed and enforced.
- by 2017 full-scale environmental protection and management projects are implemented in all priority watershed and aquatic ecosystems.
- by 2017 stakeholders are participating in environmental protection and management.
- by 2027 quality of watersheds is increased by 80% in all regions.
- by 2027 adequate water quality for aquatic habitat, including fish, human consumption and recreation is ensured in all rivers and lakes.

Plate 1: A snow-covered peak, perennial source of fresh water

Plate 2: Karnali River, mid western, Nepal

Plate 3: River training works at East Rapti River

Plate 4: Damaged Bridge in the Khahare Khola, Mugling Narayanghat Road section.

Action Programmes

Action programmes have been developed based on the ten broad headings identified by the WRS. Altogether forty-four action programmes have been finalized under nine broad headings of major activities following consultations at various regional, central and expert panel workshops. Effective implementation of these recommended actions will definitely meet the objectives of the water-related environment sector, thus finally meeting the objective of the NWP within the projected time. The implementation of the Environmental Action Plan will coincide with the Tenth Plan (2003-2008), then it will follow the subsequent Five Year Plan and other water-related environment plans. The major programme activities and actions are as follows:

1. Improve Environmental Database System:
   (a) Establish an information and meta data centre on water resources-related environment at WEC.
   (b) Establish meteorological and hydrological database in priority watershed systems.
   (c) Prepare an inventory of aquatic ecosystems.
   (d) Prepare pollution status data of river, streams, ponds, lakes and groundwater.
   (e) Develop nationwide groundwater monitoring system.
   (f) Collect biophysical and socio-economic information on watersheds and aquatic ecosystems.
   (g) Compile indigenous knowledge and skills on watersheds and aquatic ecosystems.

2. Map Important, Critical and Priority Watersheds and Aquatic Ecosystems:
   (a) Prepare land use map of important, critical and priority watersheds, aquatic ecosystems, pasture and the Siwaliks/Churia range.
   (b) Identify important, critical and prioritized watersheds and aquatic ecosystems based on the latest land use map.
   (c) Develop high-resolution maps of important, critical and prioritized watersheds, aquatic ecosystems, pasturelands and Siwaliks/Churia.
   (d) Prepare erosion hazard maps.
   (e) Prepare hydro and meteorological maps.
   (f) Update maps on regular basis.

3. Develop Water and Wastewater Quality Standards and Regulations:
   (a) Develop water quality standards/guidelines for irrigation, drinking and recreational purposes.
   (b) Set up water quality standards/guidelines for ecosystems maintenance.
   (c) Develop standards/guidelines for the discharge of municipal and industrial wastewater.
   (d) Establish minimum in-stream and outflow in important aquatic ecosystems.

4. Implement Water Conservation Education Programme:
   (a) Design and implement a training programme on soil and water conservation.
   (b) Support academic/training institutions to incorporate a water and environment management course.
   (c) Develop an environment awareness programme.

(d) Promote research and studies on ecological water requirements, water quality, functioning of glacial lakes, existing dam structure and climate change and its impact on the environment.
(e) Support the mass media for water and environment management.

5. Implement nationally important Watersheds and Aquatic Ecosystems Protection, Rehabilitation and Management Programmes:
   (a) Prepare watershed management plan of important, critical and priority watersheds.
   (b) Prepare management plans for important, critical and prioritized aquatic ecosystems.
   (c) Implement a rehabilitation programme on degraded watersheds.
   (d) Implement a land productivity conservation programme in priority watersheds.
   (e) Implement a Siwaliks/Churia conservation programme.
   (f) Promote the Special Area Land Treatment (SALT) model.
   (g) Implement an industrial pollution control programme.

6. Develop Strategic Environmental Assessment in Water Resources Management:
   (a) Make provision for legal instruments for the Strategic Environmental Assessment (SEA) in the water resources sector.
   (b) Apply SEA to the water resources management and development.

7. Ensure Compliance with Environmental Impact Assessment (EIA):
   (a) Reassessment of EIA Acts, rules, regulations and processes.
   (b) Develop/approve EIA guidelines for irrigation, hydropower, drinking water and other economic uses of water.
   (c) Strengthen compliance monitoring system.

8. Promote Community Participation in the Management of Watersheds and Aquatic Ecosystems:
   (a) Provision of legal arrangements for the management of aquatic ecosystem through community participation.
   (b) Establish community-based institutions.
   (c) Strengthen institutional capacity.
   (d) Promote community-based research and demonstration.

9. Enhance Institutional Capacity and Coordination:
   (a) Designate a lead institution responsible for the management of aquatic ecosystems and pollution control.
   (b) Strengthen capacity of government institutions.
   (c) Establish coordination committees to integrate watershed and aquatic ecosystem management programme and water-based infrastructure development projects.
   (d) Promote a cost-sharing approach.
   (e) Promote involvement of NGOs.
   (f) Establish a coordination body.

10. Develop Watershed Management Policy.

The project portfolio for environmental sub-sector is presented in Annex 2.

Table 4.3: Estimated Programme Costs for Environmental Action Plan (NRs millions at 2003/04 price level)

S.N.	Programmes	Short Term	Medium Term		Long Term		NWP Total
		10th Plan	11th Plan	12th Plan	13th Plan	14th Plan	
1	Improvement of Environmental Database System	1 226.3	78.2	10.0	0.0	0.0	**1314.5**
2	Mapping of Important, Critical and Priority Watersheds and Aquatic Ecosystem	186.5	25.0	21.0	15.0	11.6	**259.1**
3	Development of Water and Wastewater Quality Standards and Regulations	50.0	25.0	25.0	15.0	12.1	**127.1**
4	Implementation of Water Conservation Education Programme	375.0	726.8	726.8	726.8	726.8	**3282.0**
5	Implementation of Pilot Watersheds and Aquatic Ecosystem Protection, Rehabilitation and Management	250.0	540.1	540.1	540.1	540.1	**2410.2**
6	Development of Strategic Environmental Assessment in Water Resources	15.7	0.0	0.0	0.0	0.0	**15.7**
7	Ensuring of Compliance with EIA	4.7	0.0	0.0	0.0	0.0	**4.7**
8	Promotion of Community Participation in the Management of Watersheds and Aquatic Ecosystems	212.0	211.8	211.8	211.8	211.9	**1059.2**
9	Enhancing of Institutional Capacity and Coordination	15.5	15.5	15.5	0.0	0.0	**46.5**
	Total	**2 335.7**	**1622.2**	**1550.1**	**1508.6**	**1502.5**	**8519.0**
	%	**27.4**	**19.0**	**18.2**	**17.7**	**17.6**	**100.0**

4.2.2 Use Aspects

4.2.2.1 Water Supply, Sanitation and Hygiene

Current Status

Adequate water supply and sanitation is a high social objective. The water supply and sanitation sector has made significant progress within a relatively short period. In 1970, only 6% of people living in rural areas had access to a protected water source. During the International Drinking Water Supply and Sanitation Decade (1981-1990), this figure rose to about 34%. This was made possible through significant increases in investments. There are over twenty international donor agencies active in the water supply and sanitation (WSS) sector. Only few, however, work directly with the Department of Water Supply and Sewerage (DWSS), which is the lead agency in the sector.

The major issues and challenges that may be associated with the sector are lack of clear roles and responsibilities of the different sector agencies, resource gaps in meeting the set targets, long gestation periods of sub-projects resulting from inadequate budget allocation, lack of coordination, duplication of efforts, rehabilitation of schemes built in the 1970s and 1980s, lack of proper drinking water quality and pollution control guidelines, absence of sound cost recovery mechanisms leading to high subsidies on O&M of urban systems, greater focus on software components of programmes such as health and hygiene, education, non-formal education, income-generating activities, Management Information System (MIS), and poor monitoring and evaluation due to ineffective regulatory mechanisms.

Following the restoration of multiparty system, NGOs emerged as an important player in the rural water supply and sanitation sector. The WSS sector has now emerged as a pluralistic sector with a variety of delivery approaches promoted by different agencies involving CBOs. However, Nepal's drinking water supply and sanitation sector developed in an uncoordinated manner. It operates at low levels of efficiency and in isolation from other relevant line agencies such as the Ministries of Health and Education. But, the current number of agencies operating and the degree of pluralism seen mean that the coverage will undoubtedly continue to climb, though in a poorly targeted and irregular manner.

The Tenth Plan document has reported the water supply and sanitation coverage at the end of the Ninth Plan (July 2002) as follows:

Table 4.4: Water Supply and Sanitation Coverage

Water Supply Coverage (Population in '000s)						
Region	Rural		Urban		Total	
	No. of Benefited	%	No. of Benefited	%	No. of Benefited	**%**
Eastern	2917	61	471	70	3 388	**62**
Central	4 252	65	1 465	85	5 716	**69**
Western	3 216	79	412	72	3 628	**78**
Mid-West	2 284	80	168	70	2 452	**79**
Far-West	1 719	85	114	46	1 833	**81**
Total	**14 388**	**71**	**2 630**	**76**	**17 017**	**71.6**
Basic Sanitation Coverage:			(Population in Thousand)			
Basic Sanitation	Rural		Urban		Total	
	4 094	20.0	1 826	53.0	6 920	25.0

Source: Tenth Five Year Plan, NPC October 2002.

However, the latest census, 2001, has estimated the water supply and sanitation coverage as follows.

Table 4.5: Water Supply and Sanitation Coverage by Ecological Regions (2001 census)

	Sanitation %	**Water Supply %**	**Sanitation Gap %**
Terai	38	89	51
Hills	56	75	19
Mountains	40	72	32
National	48	82	34

Source: National Census 2001.

The coverage figures from different sources are inconsistent with each other and, therefore, there is need for creating a sound database based on updated district and village profiles. The coverage figures of NGO programmes generally tend to be overlooked. With the inclusion of all programmes in the district development plans and proper monitoring and evaluation, more reliable data may be expected to be available in the future.

The water supply service levels have been classified as high, medium and basic with respect to four standards, viz quantity, availability, reliability and quality. Sanitation service levels have been categorized as follows:

1. On-site sanitation services to the rural communities as follows:
    - pit latrine
    - VIP latrine
    - pour-flush latrine

(Choice of latrine type in terms of design and technology will depend on soil condition, economy and water facilities available).

2. For urban communities, the options available are:
    - Toilets connected to individual septic tanks
    - Toilets connected to sewerage system in core urban areas where residents can afford to share the capital investment as well as the O&M costs

3. Public toilets in community centres and other service/work areas; and common toilets in poorer communities that have no access to land for individual toilets.

DWSS has begun to play the role of a facilitator. It is also the lead agency in the sector. With the enactment of the LSGA 1999, necessary legal provisions have been made for a strong policy mandate for decentralized planning and implementation in the drinking water supply and sanitation sector. This augurs well for the sustainability of the sector by virtue of local-level decision-making, transparency, participatory approach and accountability professed therein.

Targets

Taking into consideration the Mid-Term Expenditure Framework (MTEF) of the NPC and the growing resource constraints, the targets set in the WRS 2002 have been revised as follows:

By 2007

- Eighty-five per cent of the total population has access to water supply.
- Eight per cent of the population has medium or high water supply service level.
- Fifty per cent of the population is provided with basic sanitation facilities.

By 2012

- Ninety per cent of the population has access to water supply.
- Fifteen per cent of the population has medium or high water supply service level.
- Ninety per cent of the population has access to basic sanitation facilities.

By 2017

- Hundred per cent of the population has access to water supply.
- Twenty-seven per cent of the population has medium or high water supply service level.
- Hundred per cent of the population has access to basic sanitation facilities.

By 2027

- Fifty per cent of the population has medium or high water supply service level.

Action Programmes

The focus of the water supply and sanitation programme is to place priority on increasing water supply and sanitation coverage, even at basic level, over the next five years. In the following ten years, full coverage of drinking water supply and sanitation will be provided at the same time as improvements are being made to the existing services. By the end of twenty-five years, all people will be benefiting from adequate water supply and sanitation, along with related health improvements.

Different modalities are currently being developed and applied, and it is expected that by the mid-term plan, a uniformly accepted modality will be in force, financed under a basket system to which all development partners, including central- and local-level government agencies, will be contributing. Implementing agencies will be required to develop sound demand-driven projects meeting certain minimum requirements to be eligible to receive funding from these sources.

For rural water supply and sanitation programmes, selection criteria are designed to cover unserved and underserved people most in need of the services. HDI, being a composite indicator, will be one of the important tools in the selection of districts to launch the programme. Though water supply coverage in the Far-Western Development Region of the country is high, Bajhang district, for instance, has an HDI of 0.201 due to low heath impact, high construction costs, remoteness and access difficulties, combined with a mobile population. This district has, therefore, received highest priority in a recent analysis, done by applying selection criteria designed under the Community-based Water Supply and Sanitation Project (CBWSSP). Similar selection criteria have been developed in the case of the Small Towns and Major Towns programmes as well. Six programmes have been identified and their key elements are enumerated below.

1. Accelerated Stand-Alone Sanitation Improvement Programme (ASASIP)
   The national sanitation coverage as reported in the National Census 2001 has been estimated at 48%, whereas the water supply coverage is 82%, resulting in a sanitation coverage gap of 34% (water supply coverage less sanitation coverage). This highlights the need for ASASIP. The key elements are:

   (a) Integrate capacity building at the grass roots and district levels with national sanitation and environmental sanitation campaigns, community-based hygiene and environmental sanitation support, and school sanitation as part of the overall hygiene and health education activities covering all the seventy-five districts.
   (b) Devise strategies to make sanitation programmes effective and locally relevant for urban and rural areas.
   (c) Assist VDCs to formulate and implement village environmental hygiene plan and municipalities and DDCs to prepare sanitation profiles.

2. Rural Water Supply and Sanitation Programme (RWSSP). The key elements are:

   (a) Provide water supply services for 11,815,000 people through current approach as an integral part of water supply, sanitation and hygiene education to services.
   (b) Establish and operate a District Rural Water Supply and Sanitation Development Fund (DRWSSDF), to which all development partners, including donors, HMGN, DDCs and VDCs contribute.
   (c) DRWSSDF to invite proposals from all interested parties in the sector and those eligible or qualified to be funded by the DRWSSDF.
   (d) Encourage, educate and prepare communities for implementing need-responsive projects through intensive interaction and support.
   (e) Establish an O&M fund upfront with cash contribution from the community for meeting the O&M cost.

(f) Ensure mechanisms to serve socially and economically disadvantaged groups, allowing reduction in community contribution to 10%.
(g) At the grass roots level, promote gender sensitization, non-formal education and income-generating activities, where applicable.

3. Small Towns Water Supply and Sanitation Programme (STWSSP).The key elements are:

(a) Implement the STWSS programme to cater to about 500 emerging towns with a total population of approximately ten million and upgrade the service level to medium, benefiting 7,206,000 people in five phases.
(b) Construct proper sewerage systems in the core areas and on-site sanitation in the remaining areas.
(c) Ensure and formalize ownership and O&M of the completed systems by the municipalities/WUCs under specified terms and conditions and regulated by the National Water Supply Regulatory Commission (NWSRC) in a gradual manner.
(d) Enable and empower municipalities/WUCs through capacity-building initiatives to maintain and manage community-owned systems.
(e) Devise mechanism for full O&M cost recovery, including partial capital cost recovery, within an agreed period.

4. Kathmandu Valley Water Supply and Sanitation Programme (KVWSSP). The key elements are:

(a) Commission the Melamchi Water Supply Project by 2012 to upgrade services with high level to an additional population of 1,553,000 and the Yangri Water Supply Project for additional 1,500,000 beyond 2017.
(b) Recruit a management contractor for the operation and management of the water utility under a performance-based management contract for six years for the proper management and improvement in the distribution network in phases, as funds become available.
(c) Draft, enact and enforce the Water Supply Board Act and the NWSRC Act.
(d) Establish Kathmandu Valley Water Supply Board, Water Utility Operator and NWSRC and make them fully operative.
(e) Adopt a tariff policy ensuring full O&M cost recovery in the interim period, leading to partial capital cost recovery (50%) in a gradual manner.
(f) Implement a phased programme for wastewater system improvement and treatment, leading to separate sanitary and storm water sewerage systems for cleaning up the water courses in the Kathmandu valley.

5. Major Towns Water Supply and Sanitation Programme (MTWSSP). The key elements are:

(a) Implement the programme in fifty-three municipalities outside the Kathmandu valley to upgrade the WSS services to high level, benefiting a population of 5,235,000.

(b) Enable and equip the municipalities to own and manage the WSS systems under an agreement with specific terms and conditions to be regulated by the NWSRC in a gradual manner.
(c) Empower municipalities through proper capacity building to undertake the services efficiently.
(d) Devise mechanisms to ensure full O&M cost recovery in the interim, leading to financial equilibrium with 50% capital cost recovery within an agreed period as set out in the agreement.
(e) Implement the following work envisaged under the programme:
    (i) Rehabilitation of the existing water supply systems;
    (ii) Construction of new water supply systems;
    (iii) Cleaning, rehabilitation and extension of the existing sewerage systems;
    (iv) Installation of new sewerage systems in the core areas and promotion of on-site sanitation in the remaining areas;
    (v) Solid waste management activities; and
    (vi) Community development and poverty alleviation activities.

6. Water Supply and Sanitation Institutional Strengthening Programme (WSSISP). The key elements are:
(a) Draft, enact and enforce the Water Supply Fund Act, the NWSRC Act, the Fund Board Act and revisions to the DWS regulations.
(b) Finalize draft guidelines, enact and enforce the Drinking Water Quality Guidelines and implement a monitoring and surveillance programme.
(c) Define clearly and delegate roles and functions of key sector institutions: DWSS for policy, planning, programming, and monitoring and evaluation, as well as facilitating and implementing roles and responsibilities of the Fund Board and other implementing agencies, MoLD and other Ministries, DDC, VDC and NGOs.
(d) Implement measures to empower local bodies through the strengthening and capacity building of local bodies.
(e) Regularly update the database and MIS for effective planning, monitoring and evaluation of projects.
(f) Establish and support NWSRB and develop mechanisms for the same.
(g) Devise measures and mechanisms to effectively mobilize NGOs and the private sector for supporting the sector programmes.
(h) Prepare guidelines for effective water source conservation and protection measures.
(i) Devise mechanisms for effective monitoring and evaluation of the programmes at various levels.
(j) Devise detailed measures in line with the Water Supply Board Act to devolve Nepal Water Supply Corporation (NWSC) and the urban jurisdiction of the DWSS, ensuring alternate ownership and management mechanisms as per the requirement of the municipality or group of municipalities.
(k) VDCs and DDCs to prepare and maintain basic database of all districts.
(l) DWSS to make arrangements for the dissemination of the available seventy-one district profiles to enable and require VDCs and DDCs in preparing and regularly updating the water and sanitation profiles.

(m) Establish a mechanism whereby DWSS continues to update or prepare district profiles for both water supply and sanitation.
(n) Establish and equip regional-, divisional- and district-level agencies to carry out monitoring and training support for VDCs and DDCs.
(o) DWSS, as the lead agency in the sector, to ensure coordination amongst all agencies concerned (government as well as non-government) and sharing of experience and data through regular meetings.
(p) Develop a clear and long-term policy and strategy regarding subsidy on STW programmes.
(q) Rural WSS Policy/Strategy 2004 to be disseminated to all district-level agencies, including the NGOs and INGOs engaged in the WSS sector.
(r) DWSS to provide guidelines and training for DDC officials regarding formation, management, accounting, etc of the DRWSSDF.
(s) Districts/DDCs to be encouraged to establish their own WSS funds. This should initially be applied to small schemes.

The project portfolio for drinking water supply and sanitation projects is presented in Annex 3.

Table 4.6: Estimated Programme Costs of Water Supply and Sanitation (NRs millions at 2003/04 price level)

S.N.	**Programmes**	Short Term	Medium Term		Long Term		NWP Total
		10th Plan	11th Plan	12th Plan	13th Plan	14th Plan	
1	Rural Water Supply and Sanitation Programme	4166.5	6089.0	15558.7	5764.5	5643.6	**37222.2**
2	Small Towns Water Supply and Sanitation Programme	3520.6	5465.0	10024.7	19696.5	20164.9	**58871.8**
3	Kathmandu Valley Water Supply and Sanitation Programme	17116.1	24878.1	7900.4	11009.9	9542.2	**70446.7**
4	Major Towns Water Supply and Sanitation Programme	3526.1	4584.1	13162.7	13891.7	19157.3	**54321.9**
Total	Total Investment plus O&M	28329.3	41016.2	46646.5	50362.6	54508.1	**220862.7**
	Non-structural Cost	699.5	1728.7	2304.9	2881.1	2881.1	**10495.4**
	Total Programme Cost (capital + O&M + non-structural)	**29028.8**	**42744.9**	**48951.4**	**53243.7**	**57389.3**	**231358.1**

The above cost estimates are based on the relevant per capita cost assumed for the programme. The per capita cost adopted also includes the cost of sanitation, health and hygiene education. Depending on the ecological region and pertinent programme, the cost of the appropriate on-site sanitation option plus the associated health and hygiene component is expected to vary from NRs150.00 to NRs500.00 per capita. Non-structural costs include ASASIP and WSSISP programmes costs.

4.2.2.2 Irrigation for Agriculture

Current Status

Irrigation has been established as the prime contributor to improving agricultural production and to stabilizing agricultural production in the country. The crop production has been just able to keep pace with the population growth during the last forty-five years. While the population of Nepal was 9.4 million in 1957, the food grain production stood at around 2.84 million tons; in 2002, the population was around 23.5 million and the food grain production was

around 7.24 million tons3. The cultivated land also has expanded from 1.4 million ha to 2.64 million ha during the same period.

The population is projected to reach over 38 million by 2025 and the corresponding requirement of food grain will be close to 12 million tons. The scope of further expansion of arable land has diminished, and, therefore, the increase in food grain production depends mainly on the growth in agriculture productivity. Potential does exist in Nepal to substantially increase food grain productivity. The average food grain productivity increased from 1.83[♣] ton/ha in 1957 to 1.99 ton/ha in 2002.

The productivity of paddy, which is the major staple food for a large majority of the population, grew from 1.9 ton/ha in 1957 to 2.45 ton/ha in 2002, whereas the potential to increase the productivity of paddy at the present level of technology in Nepal remains at about 4.0 ton/ha. Similar increase in productivity potential exists in other cereal crops such as wheat and maize.

Irrigation water, besides improved variety of seeds, fertilizers, credit facilities and access to market, is the main input for increasing productivity by increasing the cropping intensity for agriculture production. Irrigation reduces the risk by diminishing the adverse effects of rainfall variation and uneven water supply on crop growth and yield. The reduction in risk provides an incentive to use cash inputs at optimal level. It also permits farmers to switch to a higher value crop mix. The existing average cropping intensity for cereal crops in the country is 12% mainly due to the non-availability of irrigation water, whereas the total cropping intensity, including other crops, is 159.3%. The cropping intensity where irrigation is available round the year has gone up to 220%. Irrigation efficiency in the country is assumed to be below 30% at present.

Out of the total cultivated land area estimated at 2.64 million ha, the potential maximum net irrigable land is about 1.76 million ha. The total irrigated land was 0.764 million ha, whereas the net irrigated area for which infrastructure was available was estimated at 1.121 million ha in 2002. Out of this, only about 0.50 million ha of land had round-the-year irrigation facilities. Ample opportunity exists for expanding the irrigation facility to additional 0.6 million ha of irrigable land, whereby food security of the country can be ensured at least for a foreseeable future. About 67% of the cultivated land (1,766 thousand ha out of 2,641 thousand ha) in Nepal was reported to be irrigable. Analysis of the distribution pattern of irrigable land in different ecological regions indicates that about 24% (55 thousand ha out of 227 thousand ha) of the cultivated land in the mountains, about 34% (355 thousand ha out of 1,054 thousand ha) in the hills and almost all the cultivated land (1,356 thousand ha out of 1,359 thousand ha) in the terai are irrigable.

In Nepal, FMISs have a long history; over 15,000 irrigation systems are operated and managed by farmer groups. Even at present more than 60% of the irrigated land is managed by farmers' WUAs. The government has the policy of handing over irrigation systems to farmer communities for operation and management. The irrigation programmes are to be demand driven and farmers are expected to play a key role during all the phases of irrigation development with full participation, where participation of women farmers is critical.

[♣] Source: Poudel, S. N. in *Nepal Ma Sinchai* (Irrigation in Nepal); Jalsrot Vikah Sanstha; Anam Nagar, Kathmandu; Chaitra 2059 (April 2003).

Plate 5: Drinking water supply in the village of hill area
(Photo source: Nepal Water for Health (NEWAH))

Plate 6: Kathmandu Valley, where the capital city lies is facing water scarcity problem

Plate 7: An aquaduct in the Budhi Khola, Sunsari Morang Irrigation Project

Plate 8: Upstream view of headworks, Kaligandaki Hydroelectric Project

Potential to expand round-the-year irrigation exists in the terai plains in Nepal. Out of 1.36 million ha irrigable land of the terai, only 64% has received irrigation facilities. About 768,000 ha of the cultivated land in the terai receives surface irrigation through some 2,000 schemes. In the terai, the possibility of further development of surface irrigation system by Siwalik rivers is almost minimal; however, the potential for developing groundwater for irrigation is immense in the terai. The maximum and safe abstraction of groundwater can irrigate an area of about 570,000 ha in the terai. Hence, groundwater irrigation is expected to drive the round-the-year irrigation campaign in Nepal. It has been proposed that electricity demand charge of DTW should be either curtailed or subsidized by HMG/N. Also, tubewell installation and rural electrification will be treated as infrastructure development like surface irrigation infrastructure. All 11 KV transmission lines, including transformers, will come under the rural electrification programme. The tubewell cost will incorporate only the cost of 440 volt line. A regulatory mechanism to establish safe and sustainable groundwater extraction and utilization for different uses will be in place during the short-term period of the implementation of the NWP.

Another factor for the shortfall in agriculture production compared to what is envisaged in the five-year plan documents and project appraisal reports is the lack of coordination between the government departments of agriculture and irrigation in irrigated agriculture areas. Issues relating to soil fertility and on-farm management of integrated crop management need to be addressed properly in irrigated agricultural area. These issues have been recognized by all parties and mechanisms developed for regular interaction and coordination at appropriate levels from project to central level. This coordination programme will be keenly monitored for effective implementation.

Targets

In view of the availability of human and financial resources as well as the constraints on building the institutional capacity and the trends of progress achieved during the past periodic plans, the NWP targets for the irrigation sub-sector have been revised and set as below. The revised targets are based on the objectives of food security and livelihood improvement during the NWP period.The targets are:

By 2007

- Year-round irrigation is provided to 49% of the total irrigated area (present level estimated at below 30%).
- Average cereal yield in irrigated area increases by 15% over the 2001 level.
- Average cropping intensity exceeds 140% in year-round irrigated areas.
- Average cropping intensity of cereal crops exceeds 126% and overall cropping intensity, including that of other crops, exceeds 160%.
- Seventy-one per cent of the potential area is served by irrigation systems.
- Irrigation efficiency increases to 35%.
- Irrigation service contribution collection increases by 30% of the O&M cost.

By 2017

- Year-round irrigation is provided to 64% of the total irrigated area.
- Average cereal yield in irrigated areas increases by 28% over the 2001 level.
- Average cropping intensity exceeds 164% in year-round irrigated areas.
- Average cropping intensity of cereal crops exceeds 134% and overall cropping intensity, including that of other crops, exceeds 170%.

- Eighty per cent of the potential area is served by irrigation systems.
- Irrigation efficiency increases to 45%.
- Irrigation service contribution collection increases by 45% of the O&M cost.

By 2027

- Year-round irrigation is provided to 67% of the total irrigated area.
- Average cereal yield in irrigated areas increases to 44% over the 2001 level.
- Average cropping intensity exceeds 193% in year-round irrigated areas.
- Average cropping intensity of cereal crops exceeds 143% with respect to entire cultivated area and overall cropping intensity, including that of other crops, exceeds 200%.
- Ninety-seven per cent of the potential irrigable area is served by irrigation systems.
- Irrigation efficiency increases to 50%
- Service contribution collection increases by 75% of the O&M cost.

Action Programmes

The focus of irrigation action programmes, during short term, will be to enhance food security and build a sustainable partnership between the Department of Agriculture (DoA) and the Department of Irrigation (DoI) and, jointly with WUAs, to support farmers' cropping decisions and cooperate in water management and scheme O&M. In the medium term, reliable irrigation services and efficient planning of new irrigation schemes, including those for expanding areas and those with multi-purpose uses, will be emphasized and carried out. In the long term, activities will focus on ensuring the availability of efficient, reliable and sustainable irrigation to all irrigated areas.

The agriculture market information system will be expanded, enhanced and improved through telephone and other media networking within and outside the country. A new market information system will be developed by the sub-agency of the Ministry of Agriculture and Cooperative (MoAC). The goal of this information system is to inform farmers of crop produce prices and attractive commercial opportunities in the market that encourage crop diversification.

Five action programmes and their key activities are enumerated below. In the working paper of the irrigation sub-sector, these programmes are divided into short-, medium- and long-term bases.

1. Integrated Programme for Irrigated Agriculture. The key activities are:
   (a) Launch of groundwater projects (STWs and DTWs) in new areas;
   (b) Design and implementation of crop intensification and diversification in irrigated areas;
   (c) Formulation of project to pilot voluntary land consolidation activities in two districts;
   (d) Strengthening of market improvement system for agricultural produce;
   (e) Continuation, consolidation and expansion of groundwater monitoring programmes and enhancement of regulatory measures;
   (f) Strong monitoring, evaluation and feedback of the NWP and APP activities incorporated in the department/Ministry with incentive and conduct policy-related studies to overcome hindrances encountered in irrigated agriculture, if any;

(g) Regular monitoring of groundwater for water level fluctuations and surface/groundwater quality and setting out standard for irrigation use; and
(h) A centrally-managed pilot programme under MoAC/DoA in the command area of large irrigation systems greater than 15,000 ha.

2. Improved Management of Existing Irrigation Schemes. The key activities are:
   (a) Implementation of conjunctive use of surface and groundwater programmes in the existing command areas of irrigation projects in the terai;
   (b) Rehabilitation of FMISs;
   (c) Rehabilitation of agency managed irrigation schemes (AMISs);
   (d) Rehabilitation of AMISs for management transfer to WUAs;
   (e) Implementation of command area development (CAD) work in existing AMISs to increase cropping intensity;
   (f) Implementation of adequate drainage system programmes in water-logged and inundated areas;
   (g) Improvement of on-station research and on-farm water management;
   (h) Improvement of tertiary-level water management;
   (i) Raising of irrigation service fees (ISF) in joint managed/AMISs as per the Irrigation Policy 2060;
   (j) Improvement of on-farm water management in farmers' schemes through greater farmer participation;
   (k) Improvement of the existing database (and establishment in others) on irrigation water supply and consumption; irrigation delivery; groundwater use and water table fluctuations; service fee recovery, etc;
   (l) Introduction of irrigation water delivery in volumetric basis system in some pilot schemes where WUAs are involved; and
   (m) Improvement of management of mechanical plants for scheme maintenance and also use of private institutions for the maintenance of workshops.

3. Improved Planning and Implementation of New Irrigation Systems. The key activities are:
   (a) Implementation of new surface water (SW) and groundwater (GW) irrigations projects in the hills and terai;
   (b) Expansion of micro-irrigation (such as drip irrigation system with water harvesting facilities, sprinkler system and treadle pumps, etc) for small farmers, including women farmers of the terai, hills and mountains for the development of livestock, agriculture crops and other cash crops;
   (c) Initiate multipurpose irrigation projects (with a hydroelectric generation component such as Bheri-Babai diversion, Sunkosi/Kamala diversion and West Rapti storage);
   (d) Groundwater exploration and investigation to support new GW projects.
   (e) Also groundwater recharge study developed as a programme;
   (f) Feasibility and investment studies of irrigation projects to verify their viability; and
   (g) Improvement of quality control in construction activities as well as work standards.

4. Strengthening of Capacity Building of Local Level Institutions in Planning and Project Implementations. The key activities are:
   (a) Implementation of irrigation management training to stakeholders;
   (b) Implementation of programme of digital mapping of all irrigated areas; and
   (c) Enhancement of capacity-building programmes of local government institutions to create institutional and enabling environment for the implementation of action programmes.

5. National Capacity Building of Farmers. The key activities are:
   (a) Establishment of a Water and Land Management Institute under Agriculture Institution;
   (b) Conducting of regular training for farmer functionaries at different levels; and
   (c) Implementation of capacity-building programmes on regional basis to include field and regular training.

The project portfolio for irrigation sector is presented in Annex 4.

Table 4.7: Estimated Programme Costs of Irrigation for Agriculture (NRs million at 2003/04 price level)

S.N.	Programmes	Short Term	Medium Term		Long Term		NWP (Total)
		10th Plan	11th Plan	12th Plan	13th Plan	14th Plan	
1	Integrated Irrigated Agriculture	5906.1	11775.5	14764.3	15763.8	15752.2	**63961.9**
2	Improved Management of Existing Irrigation Projects	11425.6	19153.7	19324.7	9440.4	9611.0	**68955.4**
3	Improved Planning and Management of New Irrigation Projects	4292.3	22004.3	15966.0	37491.3	52397.4	**132151.4**
4	Strengthening of Local Capacity of Planning, Implementation & Management	72.9	209.5	209.5	0.0	0.0	**492.0**
5	National Capacity Building of Farmers	0.0	275.6	275.6	220.5	220.5	**992.1**
	Grand Total	**21697.0**	**53418.7**	**50540.1**	**62916.0**	**77981.0**	**266552.8**

4.2.2.3 Hydropower Development

Current Status

Since the postulation of the potential hydropower capacity of the country at 83,000 MW in the 1960s, the dream to harness this potential for the benefit of Nepalese people has continued to enliven only the discourses among different sets of people, be it politicians, academics, water professionals or even common educated masses. But even after the lapse of more than forty years, less than 1% of this potential has been realized. It shows how complex the situation is to really overcome the ground reality in terms of constraints in financial market, inability to exploit the potential export market and limited domestic market.

As of December 2003, the total installed capacity of hydropower in the country with Nepal Electricity Authority (NEA), the public sector power utility organization, and other private power producers was 603 MW, out of which 144 MW was from eight independent power producers (IPPs) with which NEA had entered into power purchase agreements (PPA), 402 MW of hydropower from the NEA and the remaining 57 MW from thermal power from the NEA.

There are 2,175 schemes in the micro-hydro category and together they are assumed to produce a total of 14.57 MW of power for different uses, mainly for milling purposes and some electric lighting in remote and isolated areas[♦]

According to the population census 2001, 38.6% of the country's population has access to electricity from different sources. NEA alone has over 970,600 consumers and the total available electric energy in INPS was 2,260 GWh (Gigawatt hour) in 2003. Out of this, 1,740 GWh was consumed and the system loss was 23.6%. This gives the average per capita consumption of electric energy at 75 kilowatt hour (KWh) in terms of broad electricity consumption indicator. The above figure does not include isolated micro-hydro and the consumers of the Butwal Power Company.

A number of studies made so far have identified the total capacity of techno-economically viable hydropower to be 43,000 MW, whereas the maximum domestic demand even after twenty-five years is projected at less than 7,000 MW in high growth scenario. This huge potential surplus of power seems to be the main reason behind the allurement to export hydropower to neighbouring countries. Some of the issues related to hydroelectric power development in Nepal are:

A The cost of development of hydropower projects has been quite high so far and the challenge is to produce sufficient hydropower at cheaper cost and make it available at an affordable price to meet the demand of different economic sectors such as agriculture, industry, transport, domestic and others. Potential surplus electric power should be able to attract electric energy-intensive industry for high-end users such as high carbon steel, calcium carbide, fertilizer and cement industries.

B Rural electrification is a costly investment but at the same time essential for the economic uplift of the rural people. In order to make rural electrification more cost effective and financially sustainable in terms of O&M, this programme needs to be expanded and linked up with rural economic activities.

C NEA is a vertically integrated government utility that generates, transmits and distributes electricity to consumers. At present, the power system planning is being undertaken by the NEA. Such an arrangement creates an uncomfortable environment for the IPPs. In order to alleviate this situation, the power system planning needs to be done by a separate entity.

D The present system losses (both technical and non-technical) are estimated at about 24%. This aspect urgently needs to be rectified. In order to reduce losses in the system, improve efficiency and to create a competitive environment, power sector needs to be restructured.

E Hydropower development is a high investment proposition. In order to meet the future demand for power, public sector financing alone is not adequate. The next option is to attract private investment, both domestic and foreign. Creation of a fund is needed to act as a catalyst to attract private capital.

F National capabilities need to be strengthened to produce cheaper hydro energy. Employment of local expertise in terms of contractors, consultants and skilled

♦ Source: *Micro-hydro Year Book of Nepal, 2003*; HMG Ministry of Science & Technology, Alternative Energy Promotion Centre, Energy Sector Assistance Programme; 2003, November.

labour, apart from the use of materials and equipment manufactured indigenously, will reduce the cost of energy production.

- **G** Nepal has high potential for hydropower development. A number of sites have been identified and studied to be feasible. These projects have the capability to meet the power demand of the neighbouring countries to some extent. This opportunity needs to be exploited for economic uplift of the country.

Targets

Keeping in view the recent trends of progress, the following revised targets have been set.

By 2007

- → Up to 700 MW generating hydropower capacities are developed to meet the projected domestic demand at base case scenario without export.
- → Laws making participation of national contractors or consultants mandatory in all types of projects are promulgated.
- → Thirty-five per cent of the households are supplied with INPS electricity, 8% by isolated (micro and small) hydro systems and 2% by alternative energy.
- → Per capita electricity consumption of 100 KWh is achieved.

By 2017

- → Up to 2035 MW hydropower electricity is developed to meet the projected domestic demand at base case scenario, excluding export.
- → Fifty per cent of households are supplied with INPS electricity, 12% by isolated (micro and small) hydro systems and 3% by alternative energy.
- → Per capita electricity consumption of 160 KWh is achieved. and
- → NEA is corporatized.

By 2027

- → Up to 4,000 MW of hydropower is developed to meet the projected domestic demand at base case scenario, excluding export.
- → Seventy-five per cent of the households are supplied with INPS electricity, 20% by isolated (micro and small) hydro systems and 5% by alternative energy.
- → Per capita electricity consumption of over 400 KWh is achieved.
- → Substantial amounts of electricity exported to earn national revenue.
- → NEA unbundled and privatized.

Action Programmes

The focus of the hydroelectric power programme during the first five years is on identifying and developing cost-effective small and medium hydropower projects that are capable of meeting domestic needs, including groundwater pumping for irrigation, at affordable prices. At the same time, micro-hydro programmes will be continued with vigour to give access to basic minimum needs of electric power to communities not connected to the INPS.

In the following ten years, substantial benefits will be realized by maximizing hydropower development for different markets, including energy-intensive industries, transport sector and power exports. By the end of twenty-five years, the country will have a total hydropower capacity of about 4,000 MW, excluding exports, and more than 75% of all households will be provided

Plate 9: Arun River near Tumlingtar.

Plate 10: A typical mountain settlement and agricultural farming

Plate 11: White water rafting at Sunkoshi River

Plate 12: Rara Lake at Mugu, a tourist place of natural beauty

with INPS electricity. In addition, it is expected that the basic electric energy requirements of the remaining part of the population will be catered through isolated, mini and micro hydropower plants and other alternative energy sources.

Large projects will be developed mainly for export, whereas small and medium hydropower projects will cater to the domestic needs. However, multipurpose projects will be developed for both export and domestic purposes. Five action programmes have been identified and their key activities are enumerated below:

1. Programme to develop cost-effective micro, small and medium hydropower. The key activities are:
   (a) Introducing necessary steps to utilize and maximize local professional, financial, material, equipment and labour resources in hydropower projects;
   (b) Developing programmes to identify cost-effective small and medium hydropower plants;
   (c) Introducing and practising the 'value engineering' concept in hydropower projects as far as possible;
   (d) Developing small and medium size projects by mobilizing local resources;
   (e) Reviewing the re-lending rate as appropriate for public sector projects; and
   (f) Encouraging the development of projects to utilize the existing infrastructure such as transmission lines, access roads, etc.

2. Programme to enhance rural electrification. The key activities are:
   (a) Expediting the INPS grid extension activities in peri-urban and terai rural areas;
   (b) Supporting development and maintenance of isolated micro and small hydropower projects and alternative energy sources to extend hill and mountain rural electrification;
   (c) Encouraging and supporting CBOs, including women's groups, to participate in electricity distribution programmes;
   (d) Integrating cottage and agro-industry programmes with rural electrification;
   (e) Supporting micro-hydro programmes and local initiatives;
   (f) Establishing Rural Electrification Agency to expedite extension of rural electrification programmes;
   (g) Mobilizing public participation and also establish Rural Electrification Fund; and
   (h) Investing 1% royalty obtained from the hydropower projects in the hydropower infrastructure-affected VDCs for the sole purpose of expanding electrification to such VDCs.
3. Programme to Improve Power System Planning. The key activities are:
   (a) Carrying out power system planning and prepare hydropower expansion plans in a transparent manner;
   (b) Encouraging suitable types of hydropower projects to address the present seasonal imbalances in supply and demand;
   (c) Identifying and developing hydropower projects with due attention to regional balance; and
   (d) Continuing demand-side management exercises and incorporate captive plants.

4. Programme to encourage private investments in hydropower development and electric power distribution. The key activities are:
   (a) Establish an independent Electricity Regulatory Commission to create a conducive atmosphere to raise the confidence and attract private sector to invest in hydropower development;
   (b) Create an effective 'one-window' entity to support private sector participation;
   (c) Introduce levy on electricity consumption to generate more resources to the Power Development Fund, which has been created to encourage private investments; and
   (d) Make appropriate arrangements to avail of the national transmission grid to wheel electric power as well as distribution of power direct to consumers by private producers.

5. Programme for Power Sector Reform and Development. The key activities are:
   (a) Restructuring the NEA through appropriate corporatization and ultimately privatizing it before 2027;
   (b) Establishing Rural Electrification Agency at the centre to develop and support rural electrification programmes;
   (c) Establishing Hydropower Research Centre and coordinate with other existing academic and research institutions;
   (d) Implementing both technical and non-technical loss reduction programmes in power sector through effective institutional mechanisms and community participation; and
   (e) Developing Electricity Tariff Fixation Commission as an independent regulatory body (Electricity Regulatory Commission).

The project portfolio for hydropower sector is presented in Annex 5.

Annual costs for institutional restructuring and institutional requirements will continue to be managed through HMGN and public institutions' recurring budgets.

Table 4.8: Estimated Programme Costs of Hydropower Development (N Rs. million at 2003/04 price level)

S.N.	Programmes	Short Term	Medium-term		Long-term		NWP Total
		10th Plan	11th Plan	12th Plan	13th Plan	14th Plan	
1	Small and Medium Hydropower Development	29173	91873	110089	128296	149419	**508851**
2	Enhance Rural Electrification Structural	12883	12353	12353	21328	21328	**80245**
3	Improve Power System Planning	4846	8846	9230	9615	10000	**42537**
4	Encourage Private Sector Investment	-	-	-	-	-	**-**
5	Power Sector Reform and Development	156	477	552	623	704	**2511**
	Total	**47058**	**113549**	**132225**	**159862**	**181451**	**634144**

Note: The above cost does not include the cost for alternative energy.

4.2.2.4 Industries, Tourism, Fisheries and Navigational Uses

Current Status

In spite of certain improvements in the industrial and commercial environments during the past decade, the contribution of industrial sector to the total GDP has not been able to cross

the 10% level. The country's industrialization is in a very dismal state. More than 90% of the industries fall under the category of cottage and small industries.

Water and hydropower energy-based industries, so far, have not received adequate attention in the national plans. But with the adoption of the national water resources strategy on other economic uses of water, the NWP is expected to create a necessary environment in that direction, which will enhance other economic uses of water and in turn provide business and employment benefits and improve the quality of life through greater appreciation of water use in industries, tourism and recreational opportunities, aquaculture and fresh water fishing, as well as navigational water use.

Industry

In the present context, the use of water in hotel, carpet, brick, agro-based and other large water-consuming industries as well as the wastewater produced by these industries is of immediate interest. Water supply needs to be guaranteed for sustained industrial growth. Large industries to a large extent depend on groundwater extraction through DTWs and these water uses need to be regulated through licensing and effectively monitored. The industrial effluents and wastewater need to be properly treated before being discharged into water bodies or sewerage system for sustainable water environment.

Establishment of bottling plants for spring water from pristine mountain springs for export as well as domestic uses needs to be expanded and encouraged by providing a legal base and proper incentives. Himalayan spring water has exotic value and Nepal should take advantage of it.

Tourism

Water possesses significant religious and cultural value. Important religious and cultural sites are located next to water bodies; hence, it is imperative that these water bodies, be they rivers or lakes, are protected and maintained in good condition, which will not only respect the sentiments of local residents but also encourage tourism in the form of pilgrimage and at the same time protect the religious and cultural ethos of the country.

Water tourism in the form of white water rafting and kayaking is attracting domestic as well as foreign enthusiasts. The Himalayan rivers are becoming popular for such adventure tourism and provide employment for many through white water rafting private companies. Around eighty private companies run their action-packed trips on the Bhote Koshi River, situated at a road distance of 100 km east of Kathmandu. The number of annual rafters in this river alone is estimated at about 21,500. There are several other rivers that are popular for white water rafting and kayaking such as the Trishuli, Marsyangdi, Kaligandaki and Karnali. The total number of white water rafting and kayaking tourists at present is estimated at 40,000 annually and is expected to grow if the environment is conducive. While developing water projects, due consideration should be given to avoid adverse effects on water tourism.

Fisheries

Commercial fishery has great potential in Nepal, as the potential area of fishing covers an area of around 800,000 ha at present in the form of rivers, lakes, reservoirs, marginal swamps, irrigated paddy fields and pond culture.

Though small-time fishing by traditional fishermen is an age-old tradition, fish culture was popularized by HMG with foreign assistance only after planned interventions in the early 1980s. In the '80s, Nepal was able to export its fish produced from aquaculture. The per capita production of fish was below 100 grams (gm) before the HMG intervention, and reached over 1,400 gm in 2000/01. The contribution of fisheries to agriculture GDP (AGDP) reached 2.02% of current price and the share of fishery in national GDP at current price reached 0.81% (DoFD 2000/01). In terms of quantity, it is estimated that Nepal produced around 32,000 metric tons (MT) of fish in 1999/2000 and around 33,000 MT in 2000/2001. The fish production was expected to reach 35,000 MT in 2001/02. At the same time, the fish-eating habit of Nepalese people has been increasing since the mid 1980s, and, therefore, the fish export, which peaked at 1,000 MT annually in the early period of the Aquaculture Development Project, has diminished considerably and the import of fish has picked up.

Fisheries in Nepal consist of: (a) aquaculture and (b) open water fishery (capture fishery). Aquaculture is considered the fastest-growing fish production system and Nepal has achieved considerable production of fish and has great potential to increase the production to meet the challenges of food security as well as to generate employment through aquaculture.

Navigation

While planning and developing large water resources development projects involving the construction of high dams, Nepal will have to give adequate attention to develop Inland Water Transportation (IWT). IWT could open a wide horizon, hitherto not considered, for trade expansion and industrial development in Nepal. IWT is the cheapest mode of transportation. The coefficient of friction on water is very small. One horsepower can pull 4,000 kg on water, whereas on road and rail, it can move only 150 kg and 500 kg respectively. Thus, the big barges transportation can offer the lowest cost of service of any mode, except sea shipping.

Identified storage dams on rivers such as the Koshi, Gandaki and Karnali could open up navigational waterways in the hills of Nepal. The total length of navigational waterways in the Kosi basin could be around 400 km; similarly, in the Gandaki and Karnali basins the waterway lengths are around 400 and 250 km respectively. However, commercial inland waterways in dams and reservoirs are fraught with several risks, including volume of traffic, and could be quite complicated in terms of designing water locks and associated management problems during large draw down effected due to dams water releases for other purposes.

However, planning and development of downstream navigational channel, for example from the proposed Kosi High Dam to Kursela on the confluence of Kosi with Ganga in India could open a navigational route for large barges from Chatara of Sunsari to the Haldia Port in the Bay of Bengal. This looks to be a more feasible option. This will bring a sea-change to how Nepal does business with the world at large. It has been agreed, as per a 1997 agreement between Nepal and India, to study navigation channel as an integral part of the proposed Kosi High Dam.

Targets

The NWP will create an enabling environment for efficient and sustainable water use in the sub-sectors related to industry, culture and eco-tourism, fisheries and navigation as the major players primarily remain in the nongovernmental and private sectors.

Industry: Targets

- Facilitate initiatives to develop sustainable standards of practice of water use for industrial purposes and industrial wastewater effluents practices.
- Regulate downstream water pollution, mandatory provisions will be made to treat industrial effluents and compliance with water quality standards will be maintained.
- Encourage expansion of bottling of spring water for domestic uses as well as export.

Tourism: Targets

- Facilitate initiatives to develop water-based cultural, recreational and eco-tourism related activities.
- Conduct studies on water tourism such as white water rafting and kayaking and studies to identify stretches of river.

Fisheries: Targets

By 2007

- Fish production from aquaculture increases to 28,500 MT.
- Fish production with improved management of open water bodies increases to 20,000 MT.

By 2017

- Fish production from aquaculture increases to 59,000 MT.
- Fish production with improved management of open water bodies increases to 30,000 MT.

By 2027

- Fish production from aquaculture increases to 87,000 MT.
- Fish production with improved management of open water bodies increases to 68,000 MT.

Action Programmes

The following programme activities will be carried out in the fisheries and navigation sub-sector.

1. Aquaculture

1. Encouraging polyculture and integrated pond culture with low cost and high productivity technology;
2. Encouraging private sector participation in fish breeding to meet the national demand for fish seeds for pond culture;
3. Ensuring wide application of multiple harvest system among private growers to meet the demand for large fingerlings for pond culture to increase productivity;
4. Establishing mandatory coordination mechanisms in fishery research and development to cultivate synergy in the implementation of planned activities;
5. Encouraging policy reforms and amend related clauses in the DDC and VDC Acts for prolonging the leasing out of village ponds to local communities; and
6. Designing appropriate incentive structures to encourage and facilitate private sector to take up coldwater fish culture, including trout fishing.

2. Open Water Fisheries

7. Exploiting full potential of natural water bodies (rivers, lakes, reservoirs and other wetlands) to obtain sustainable fish production;
8. Install community ownership of open water bodies for fishery development;
9. Protecting aquatic environment and conserve biodiversity of fish species and other aquatic life of natural water bodies;
10. Protecting fishery resources and provide fish migration route where rivers are used for other purposes (viz. hydropower, irrigation, etc);
11. Developing sites for eco-tourism and sports fishing; and
12. Enforcing fisheries related Acts and Regulations effectively for sustainable fisheries development.

3. Navigation

13. Conducting a feasibility study for a dedicated navigational canal from Chatara to Kursela on the Ganges River in relation to the proposed Kosi High Dam.
14. Making mandatory provisions to study navigational aspect in large high dam projects.

Proramme Cost

Except for the fisheries programme, annual costs to achieve the programme targets in industry, tourism and navigational aspects will continue to be managed through HMGN's recurring budgets.

The project portfolio for fisheries is presented in Annex 6.

Table 4.9: Estimated Programme Costs of Fisheries (NRs million at 2003/04 price level)

S.N.	**Programmes**	Short Term	Medium Term		Long Term		**NWP (Total)**
		10th Plan	11th Plan	12th Plan	13th Plan	14th Plan	
1	Fisheries Development Programmes	513.4	698.6	698.6	828.7	828.7	**3567.9**
2	Fisheries Research Programme	136.9	213.9	213.9	233.4	233.4	**1031.5**
3	Vehicle and Equipment	22.0	22.0	22.0	11.0	11.0	**88.2**
4	Training	14.0	22.0	22.0	18.7	18.7	**95.5**
5	Pond Construction	121.2	556.5	556.5	278.3	278.3	**1790.8**
6	Creation of Water Body along Churia Range	22.3	111.3	111.3	222.6	222.6	**690.1**
7	Netting Equipment	11.0	27.6	27.6	16.5	16.5	**99.2**
Total		**840.8**	**1651.9**	**1651.9**	**1609.3**	**1609.3**	**7363.1**
%		11.4	22.4	22.4	21.9	21.9	100.0

4.2.3 Mechanisms

4.2.3.1 Water-related Information Systems (Decision Support System for River Basin Planning and Management)

Current Status

The Department of Hydrology and Meteorology (DHM) is the central authority with the mandate to collect, process and disseminate all hydro-meteorological information in the country. DHM maintains nation-wide networks of the following hydrometric and climatological stations (as at 2002 end):

- 136 hydrometric stations
- 22 sediment stations
- 469 precipitation stations
- 68 climatic stations
- 22 agro-meteorological stations
- 15 synoptic stations

The density of the existing hydro-meteorological stations is very thin. For developing countries, the WMO has standardized a minimum of 300-1,000 sq km per station. To meet these requirements of minimum density of stream gauging stations, Nepal requires 147 to 491 of them, whereas Nepal has only 43 stations equipped with automatic water level-recording devices. And because of the topographic and orographic features, for countries like Nepal, a higher density of stations than what is prescribed by the WMO is needed in the hilly and mountainous regions.

A functional decision support system (DSS) is the basic requirement for the IWRM and river basin planning and management. Such a DSS will have two components, viz:

(i) An information system containing basin maps, hydrological, water demand database, irrigation inventory, etc; and
(ii) An analytical system (tool) containing supply and demand assessment models.

The DSS, organized in a river basin framework, mainly addresses the following issues:

- Inventory of basin's water resources and related land
- A summary of basin's present water uses
- A projection of future water needs
- Identification of alternative decisions to meet or not to meet the indicated water needs.

Sustainable development of water resources requires intimate knowledge of the environmental conditions and relevant issues in a given drainage basin. This knowledge must be based on relevant scientific data and information. Several government agencies are involved in collecting data related to their sectoral domain. There is an urgent need to coordinate and facilitate the collection and management of and access to data necessary for the sustainable development of water resources. WEC will be given mandate to maintain an integrated and centralized database for the compilation, storage and retrieval of information on water resources development in Nepal.

Nepal is in a unique position to study the cycles and trends of the ongoing climate change in Asia. A long-term study of climate will be undertaken by establishing a Himalayan Climate Change Study Centre under the DHM.

Targets

By 2007

- ➞ The existing DHM stations are rehabilitated and equipped and appropriate human and financial resources are allocated to retrieve quality data.
- ➞ The existing forty-seven hydrometric stations in central and eastern Nepal are expanded to seventy-five well-equipped stations.

- → The existing sediment sampling stations are reviewed to enhance capabilities to collect river bed samples.
- → The number of rainfall stations is increased to 370.
- → Sufficient number of stations is equipped with telemetry facility to assist weather and flood forecasting.
- → The Himalayan Climate Change Study and Research Centre is established within the DHM.
- → Meta data of all relevant water resources data are initiated and created at WEC on river basin basis.
- → Human resources are trained to manage the information system.

By 2017

- → The DHM station network is expanded to meet the WMO standards;
- → The dissemination of relevant quality data is improved.

By 2027

- → The number of well-equipped hydrological and meteorological stations is increased to meet Nepal's requirements.

Action Programmes

The focus of the DSS during the first five years is to place priority on consolidating the available water- and land-related data, including hydrological and meteorological data, water and land use data and demographic data into a meta database and disseminating quality data to all stakeholders, whereas the focus of the integrated river basin management is to inculcate the principle and concept of the IWRM and implement appropriate DSS in water resources development.

In the following ten years, the reliability and sufficiency of quality data will be maintained and provided to the satisfaction of the data users. At the same time, the adherence to the IWRM principles in river basin management will be monitored so that the benefit of water utilization in the river basin is maximized.

By the end of twenty years, water-related information will be enhanced so that the users of information in the country will have high level of satisfaction and the IWRM is practised in river basin management with full participation of all stakeholders on the basis of equity, economic efficiency and sustainable environment.

The action programmes are also categorized in two sub-headings, viz Water Resources Information System and River Basin Management Tools.

Water Resources Information System

A functional water resources information system (WRIS) will include spatial and time series data on hydrology and meteorology, water uses and their inventory, demography and land use data, maps, etc. As water-related information and data are managed by multiple agencies, metadata covering all water-related information will be maintained at the WEC. The programmes that have been identified and their key activities are enumerated below.

1. Management of existing hydrological and meteorological network.

(a) Developing a programme to rehabilitate and equip the existing DHM stations;
(b) Developing the programme to full scale validation of hydrological and meteorological data;
(c) Setting up a hydraulic laboratory for proper and timely calibration of current metres;
(d) Regularizing publication of yearbooks by implementing Hydrological and Meteorological Information System (HIS);
(e) Establishing a network of water-related agencies to enhance coordination among agencies seeking hydrological and meteorological data.

2. Extend hydrological and meteorological networks:
(a) DHM establishing temporary hydrometric stations in collaboration with water resources project developers;
(b) Developing a programme to extend DHM networks addressing the pronounced orographic effects and install recorders with appropriate telemetry system.

3. Funding and management of hydrological and meteorological network:
(a) Developing a collaborative support programme to finance the setting up and maintenance of hydro-meteorological stations;
(b) Raising awareness among general public and legislators of the need for quality, timeliness and sufficient data so that cost-effective projects can be developed;
(c) Exploring long-term external assistance to support the DHM activities; and
(d) Exploring regional countries' assistance to support and maintain a weather forecasting and flood warning system.

River Basin Management Tools

One of the enabling requirements for the implementation of the IWRM is to make use of various analytical tools and techniques for water resources assessment, water allocation and conflict resolution. The purpose of such tools is to use the information on water, land and demography to assist in optimum decision-making. The programmes that have been identified and their key activities are enumerated below:

4. Mainstreaming IWRM and River Basin Concept:
(a) Introducing the IWRM and river basin management principles in water resources policy(ies) and legislation;
(b) Developing programmes to raise awareness of the advantages of IWRM among all stakeholders, general public, legislators, political activists, civil societies and professional societies;
(c) WEC collecting, collating and segregating all relevant data and information on a river basin basis;
(d) Encourage all data generators and providers to publish data on river basin basis; and
(e) NPC and WEC requiring statements from sector programme developers to produce 'river basin water balance' prior to getting administrative approval for all projects and programmes.

5. Develop River Basin Plans:

(a) Initiating preparation/collection of available inventory of basin's water resources and related land resources;
(b) Initiating publication of basin's present water uses;
(c) Identifying multipurpose projects based on river basin's studies; and
(d) Initiating river basin studies of priority basins;

6. Develop and Implement DSS in water resources programmes:
(a) WEC acquiring relevant software for various hydrological models consisting of statistical tools, rainfall runoff models, models to estimate hydro-meteorological parameters at ungauged locations;
(b) WEC acquiring water demand projection models such as models for estimation of crop water requirements (eg FAO's CROPWAT), power system models, models for load forecasting, generation expansion, models to predict demographic change and related econometric and financial management models;
(c) WEC acquiring water resources allocation and optimization models such as MIKE BASIN, WEAP, MODSIM, etc
(d) Employing and training human resources to become capable of efficiently running the DSS, starting outsourcing in the initial period of the programme; and
(e) Establishing networking partnership among WEC and related agencies in the private sector and academic institutions to develop and manage the DSS.

7. Establishment as well as strengthening of institutions for river basin planning:
(a) Establishing a river basin planning unit at WEC for an initial period of five years and eventually upgrade the unit to a river basin authority; and
(b) Encouraging DDC/DWRC to set up a river basin unit in their respective districts to introduce the IWRM planning system.

Programme Cost

Annual cost for institutional restructuring and institutional requirements will be partly managed through HMGN's and public institutions' recurring budgets.

The project portfolio for river basin planning is presented in Annex 7.

Table 4.10: Estimated Programme Costs for Water-related Information Systems (NRs millions at 2003/04 price level)

S.N.	**Programmes**	Short Term	Medium Term		Long Term		NWP (Total)	Share %
		10th Plan	11th Plan	12th Plan	13th Plan	14th Plan		
1	Mainstreaming IWRM and River Basin Concept	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0
2	Implementation of DSS	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0
3	Hydrological & Meteorological Network Expansion in C&E Region	100.7	0.0	0.0	0.0	0.0	**100.7**	24.1
4	Implementation of DSS	42.7	8.2	8.2	8.2	8.2	**75.5**	18.1
5	Development of River Basin Plans	60.5	90.8	90.8	0.0	0.0	**242.1**	57.9
6	Institutional Set Up for River Basin Planning	0.0	0.0	0.0	0.0	0.0	**0.0**	0.0
	Total	**203.9**	**99.0**	**99.0**	**8.2**	**8.2**	**418.3**	**100.0**
	Share	48.7	23.7	23.7	2.0	2.0	**100**	

4.2.3.2 Regional Cooperation Frameworks

Current Status

The geographical setting of Nepal is such that all the rivers of Nepal drain into the Ganges system. Four countries, viz , Nepal, Bangladesh, China and India, share the waters of the Ganges Basin. Nepal, China and India are upper riparian countries, whereas India is also a middle riparian and Bangladesh a lower riparian country. Eventually, the Ganges Basin countries have to cooperate bilaterally and regionally to sustain and optimally harness the waters of this mighty river, the Ganges.

The rivers flowing from Nepal comprise 40% of the mean annual flow and 70% of the dry season flow of the Ganges. The annual flow volume of the Ganges is estimated at 400,000 million cubic metres and its catchments area is 1,076,000 sq km. This river basin, now home to nearly 500 million people is one of the poorest regions in the world. Trans-boundary problems of water pollution, water sharing, flooding and river channel changes afflict all three countries, viz Nepal, Bangladesh and India.

The immense quantity of water available in Nepal and the head available in its steep rivers are conducive to the generation of hydropower energy. There are many potential reservoir sites in the hills and mountain regions of Nepal to store the monsoon water. Nepal, being a relatively small and less inhabited country, may not consume all the stored water and the associated hydropower energy for its own use during the foreseeable future.

Nepal is losing its fertile lowlands and forest resources for storing the monsoon water and thus many people are affected. Regulated flows from the reservoir for hydropower generation also contribute to downstream benefits in terms of irrigation, flood control and even navigational use for the basin people. Despite the obvious potential benefits, little progress has been achieved. The countries involved should develop a better framework for cooperation.

So far, Nepal has entered into five bilateral treaties or agreements with India, viz (a) exchange of letters relating to the Sharada Barrage in 1920; (b) the Kosi agreement of 1954 and the subsequent revised agreement of 1966; (c) the Gandak agreement of 1959 and the subsequent review by an exchange of note in 1964; (d) the Mahakali Treaty of 1996 and (e) the joint commission agreement of 1987. An Electric Power Trade Agreement was also signed in 1996, but it has yet to be ratified by Nepal.

The experience of the implementation of these bilateral agreements indicates the need for a more confident approach and better understanding of benefit sharing. At the 12th SAARC Summit in Islamabad in Pakistan in January 2004, an agreement was reached on the South Asian Free Trade Agreement (SAFTA). This augurs well for regional cooperation in power trade and water resources benefit-sharing mechanisms in the coming future.

Nepal has been exchanging electric power to the tune of 50 MW with India. Recently, with the addition of several hydropower projects in the INPS, Nepal is experiencing surplus energy during wet season. An agreement has now been reached with India to increase the power exchange to 150 MW, but the limitation of power transmission lines is being experienced. Therefore, interconnection links are being constructed.

For the exchange as well as for future trade in electricity power on regional approach, there is an urgent need to extend and enhance the power transmission lines by constructing sufficient and adequate links of power transmission grids among the countries of the region, viz Bangladesh, Bhutan, India and Nepal. Efforts will be made for the implementation of the regional grid concept. Some of the issues related to regional cooperation are:

(a) Potential for export of cost-effective hydropower development in the region: Considering the immense potential for developing cost-effective hydropower and low power consumption in the domestic power market, there is a need to export hydropower to the regional power market of neighbouring countries.

(b) Potential for enhancing downstream irrigation benefits: Development of storage type hydropower projects will regulate and augment flow in the dry season to enhance downstream irrigation benefits. Therefore, there is a need for proper assessment of such benefits for mutual cooperation and benefit sharing.

(c) Potential for downstream flood control benefits: Development of storage type hydropower projects will not only regulate the flow for flood prevention but also remove the excessive silt loads downstream, resulting in controlling the tendency of the river to shift its course. There is, therefore, a need for proper assessment of such downstream benefits for mutual cooperation and benefit sharing.

Targets

By 2007

- The existing water-sharing treaties are monitored with effective mechanisms for compliance.
- Some multipurpose projects (such as the Pancheshwar Multipurpose Project) are approved and implemented.
- Power trade agreement with India is ratified or amended.
- Hydropower exchange with India to the tune of 150 MW is achieved.
- SAARC is encouraged to form a regional committee in water resource management.

By 2017

- The expected benefits are achieved from treaties and multipurpose projects.
- Riparian issues between neighbouring nations are resolved.
- Bilateral agreements for equitable water sharing signed are found to be in effect.
- Regional institutions are established and functioning properly.
- Power exchange/export to the tune of 400 MW is achieved.

By 2027

- Several joint/multi-country water resources development projects are implemented and are functioning satisfactory.
- Regional cooperation mechanisms are established and functioning.
- Substantial amount of hydropower export/exchange is achieved.

Action Programme

The focus of the regional cooperation action programmes during short-term will be to emphasize the need to develop and implement an improved framework for regional cooperation. The existing water-sharing treaties will be monitored in conjunction with an effective mechanism for ensuring compliance. Nepal will evaluate regional water use demands and the potential for

hydropower trade with its neighbours and will continue to explore appropriate treaty mechanisms for equitable sharing of water.

In the following ten years, expected benefits from multipurpose projects, such as Pancheshwar, will be realized; riparian issues between neighbouring countries will be resolved; and effective bilateral and multilateral agreements for equitable water sharing will be in place. By the end of twenty-five years, various bilateral and multilateral projects for irrigation, hydropower, flood control, transmission grid and navigation will be completed and substantial mutual benefits will be achieved. The action programmes and their key activities are enumerated below:

1. Programme to appraise and understand the water-related needs of neighbouring countries. The key activities are:
   (a) Establishing a cell at WEC to assess the regional water-related issues;
   (b) Establishing a database, develop strategies and enhance negotiating capabilities;
   (c) Assessing the electrical energy needs of the neighbouring countries;
   (d) Exploring strategies and alternatives for water sharing, together with downstream benefits and navigational possibilities; and
   (e) Exploring opportunities for enhancing regional cooperation in power sector.

2. Programme to pursue confidence-building measures with neighbours. The key activities are:
   (a) Expanding power exchange activity to 150 MW by 2007 and to 400 MW by 2017;
   (b) Ratifying or amending the power trade agreement between Nepal and India;
   (c) Promoting Track II and III interactions among basin countries;
   (d) Improving the mechanism for data and information exchange; and
   (e) Formulating a general framework of cooperation in development and management of trans-boundary rivers, including an agreement on downstream benefits.

3. Programmes to implement mutually beneficial development activities. The key activities are:
   (a) Forming Mahakali River Commission to implement the Pancheshwar Project;
   (b) Activating the Nepal-India Joint Commission under the 1987 agreement;
   (c) Reviewing and pursuing for compliance with the provisions of the Kosi and Gandak agreements;
   (d) Pursuing the study and implementation of the Kosi High Dam and Sunkosi-Kamala Diversion Project, including navigational access to sea; and
   (e) Exploring other multipurpose projects with bilateral or multilateral benefits.

Programme Costs

The annual costs for regional cooperation programme will be managed through HMGN's recurring but increased budgets.

4.2.3.3 Legal Frameworks

Current Status

Legislation is based on explicit policy principles designed by the State on specific sectors. There are currently three sets of policies within the water sector, viz policies on hydropower

development, irrigation and drinking water supply and sanitation. However, an integrated and comprehensive water resources policy isn't yet in place, though Water Resources Act 2049 and Water Resources Regulation 2050 have been promulgated.

The Water Resources Strategy 2002 specifically lays down an activity to 'prepare an Integrated National Water Resources Policy and amend the Water Resources Act' during the NWP preparation. During the preparation of an action programme for policy and legal framework, it was realized that unless a draft Integrated Water Resources Development Policy was prepared, it would be futile to proceed further in other activities such as amending and harmonizing the existing legislation.

Immediate attention should be given to resolve the contradictory clauses between the WRA and various other enactment.

Groundwater resources are currently not properly conserved and used due to lack of effective legal provisions. At one point, it was suggested that a separate Act relating to groundwater uses would be needed, but now it has been proposed for inclusion in the proposed comprehensive Water Resources Act, which covers the use of groundwater for various purposes such as drinking, irrigation, industrial, commercial and others. Municipalities, local communities and private sector are expected to play an increasing role in the utilization and sustainable use of the groundwater.

Issues relating to settlement, rehabilitation, involuntary acquisition and compensation to the project-affected families become a constraint whenever a development projects is underway. The existing Land Acquisition Act 2034 is restrictive in nature and is distinct from the liberal concept of individual property rights enshrined in the Constitution of the Kingdom of Nepal. Hence, there is an urgent need for amending it as well as the related rules to conform with the spirit of the Constitution.

It is now a declared policy of the government to attract private foreign investment in the economic development of the nation and provide appropriate incentives to mobilize them for financing the infrastructure development activities of projects in the water and energy sector. The Acts relating to foreign investments need to be reviewed regularly in order to create private investment-friendly environment.

Targets

By 2007

- Integrated Water Resources Policy is approved.
- Sub-sector Policies, Acts and Regulations are reviewed.
- Water Resources Act/Regulations are amended and enacted.
- Conflicting water-related laws are amended.
- Water use rights are established.
- People are made aware of water rights and obligations.

By 2017

- Water laws are reviewed and amended to changed circumstances.
- Compliance with Acts and Regulations is achieved.
- Conflict resolution mechanisms are developed and 90% of conflicts are resolved within three months.

- All water use rights are registered and reviewed.

By 2027

- WRA/Regulations are reviewed and amended to changing circumstances.
- Water-related conflicts decrease and those remaining are resolved faster.

Action Programmes

An Integrated Water Resources Development Policy has now been prepared for discussion and deliberation. Similarly, based on the proposed policy, a new Water Resources Act and Regulations have also been framed. The Policy, the Act and the Regulations will be adopted as soon as possible in consultation with all stakeholders and with due compliance of governmental procedures.

WEC will initiate or make arrangements to get the legislation related to water resources management reviewed, amended and harmonized. This process will be completed by 2007. The legislation needing the activity mentioned above is but not limited to:

1. Review of the Water Resources Act 2049 and Regulations framed thereunder;
2. Enactment of a new Water Resources Act;
3. Revision and formulation of Regulations under the new Water Resources Act;
4. Environment Protection Act 2053 and Regulations framed thereunder;
5. Local Self Governance Act 2055 and Regulations;
6. Soil and Watershed Conservation Act 2039 and Regulations;
7. Country Code (Muluki Ain) 2020;
8. Forestry Act 2049;
9. Wildlife and National Park Conservation Act 2042;
10. King Mahendra Trust for Nature Conservation Act 2039;
11. Aquatic Animals Protection Act 2017;
12. Industrial Enterprise Act 2048; and
13. Nepal Agriculture Research Council Act 2048.

Programme Cost

Costs of the activities related to legal framework, including policy revisions and drafting of necessary legislation, will be managed through the HMGN's recurring budgets.

4.2.3.4 Institutional Mechanisms

Current Status

As mentioned elsewhere, water resources development is a multi-sectoral and interdisciplinary endeavour. Institutional mechanisms for water sector management assumes a critical component for the success of the overall plan implementation, as institutions play a vital role in the operationalization of policies and plans. In water resources development and management, not only public agencies but also various stakeholder institutions, including water users' organizations, private sector entrepreneurs, NGOs, academic institutions and professional bodies, are intimately involved. The role of public agencies is vital in many respects.

The administration and management of water resources in the public sector currently is patterned along sub-sector uses. Till recently, development, rather than integrated management and sustainability of water work, has been given greater emphasis, although integrated water resources management on the river basin basis appeared for the first time in the Sixth Plan. This is mainly because of the failure to establish an appropriate institutional framework or mechanism to give effect to such policy thrust.

The elements of water policy framework include integrated approach to water management, stakeholders' participation, decentralized management and delivery of services, and equitable and sustainable management. Consequently, an appropriate institutional framework for implementation needs to be developed, applying a system of participatory management and decentralized delivery structures. These structures or agencies must be provided with clear-cut and defined responsibilities for the effective implementation of the NWP.

Following the enactment of the WRA and related Regulations and the Local Self-Governance Act, there is a definite shift towards community participation in service delivery, greater reliance on the private sector, and planning, regulation and management of water resources development by local government bodies. The government is moving towards pluralistic system of management in conducting the affairs of the State.

The Irrigation Policy 2003 has, among others, provided mechanisms for maintaining coordination between agriculture and irrigation at various levels. Similarly, the National Water Supply Sector Policy 1998 visualizes a shift from the traditional role of a service provider or implementer to the role of a supporter or facilitator. Overall management of drinking water supply will eventually be handed over to users' committees or private sector, or both. In the same vein, the Hydropower Policy encourages private sector involvement following the economic liberalization policy of the government.

The organizational structure of water administration has three levels, viz coordination and policy, implementation and operational, and regulatory. At the coordination and policy level, the following organizations are in place:

(a) National Development Council (NDC)
(b) National Planning commission (NPC)
(c) National Water Resources Development Council (NWRDC)
(d) Water & Energy Commission (WEC), and
(e) Environment Protection Council (EPC).

The following Ministries are by and large involved in coordination and policy formulation:

(a) Ministry of Water Resources (MoWR)
(b) Ministry of Physical Planning & Works (MPPW)
(c) Ministry of Science & Technology (MoST)
(d) Ministry of Local Development (MoLD)
(e) Ministry of Agriculture & Cooperatives (MoAC)
(f) Ministry of Environment, Science and Technology (MoEST)
(g) Ministry of Forest & Soil Conservation (MoFSC) and
(h) Water & Energy Commission Secretariat (WECS).

At the implementation and operational level, the following government departments are involved:

(a) Department of Irrigation (DoI)
(b) Department of Electricity Development (DoED)
(c) Department of Water Induced Disaster Prevention (DWIDP)
(d) Department of Water Supply and Sanitation (DWSS)
(e) Department of Agriculture (DoA)
(f) Department of Hydrology and Meteorology (DHM)
(g) Department of Local Infrastructure Development & Agricultural Roads (DoLIDAR)
(h) Department of Forests (DoF)
(i) Department of Soil Conservation & Watershed Management (DSCWM) and
(j) Department of National Park & Wildlife Conservation (DNPWC)

Similarly, at the operational level, there are a few parastatal organizations such as the Nepal Electricity Authority (NEA) and Nepal Water Supply Corporation (NWSC) besides the regional and district offices of the government and especially constituted boards such as the Melamchi Water Supply & Development Board (MWSDB) and Ground Water Resources Development Board. Local government bodies such as DDCs, VDCs and municipalities as well as WUAs also operate at the operational level.

At the level of regulation, which is an important function of the government, there aren't any permanent and full-time organizations in place. There are, however, committees and commission such as the District Water Resources Committee (DWRC), Water Resources Utilization Investigation Committee and Electricity Tariff Fixation Commission (ETFC), established under different Acts, to regulate tariff fixation and to resolve disputes in the water sector.

Issues relating to Institutional Reforms

The WRS recognizes the need for developing the water resources in an integrated and sustainable manner, involving stakeholders in all water management initiatives. A review of the existing government organizations in the water resources sector indicates the absence of an appropriate institutional framework for integrated management. There is also a need to create new organizations, re-define the functions of some of the existing organizations, rationalize the organizational structure and re-structure some organizations to achieve the stated objectives enumerated in the WRS. Problems relating to institutional framework and mechanism, which were identified during strategy formulation and which still persist, are:

- Absence of an effective central planning organization (despite mandating WECS as the central water planning body);
- Blurred responsibilities between policy, implementation, operational and regulatory institutions;
- Absence of an institutional framework for coordinated and integrated development;
- Jurisdictional overlaps and challenges of maintaining coordination between public and local bodies; and
- Absence of an effective mechanism for institutional cooperation for the development of international watercourses.

The policy shift to community participation and private sector involvement has necessitated behavioural changes in government institutions and strengthening of relevant non-governmental institutions. Operationalization of this policy thrust needs to be urgently addressed with appropriate institutional capacity building.

Targets

By 2007

- WEC is designated and empowered to coordinate national-level planning for the entire water sector.
- The rights and duties of all relevant institutions at all levels are clearly defined and available, and their accountability demonstrated.
- Twenty-five per cent of local level projects are planned, implemented and managed at the local level.
- River basin planning concept is agreed to and approved by HMG.

By 2017

- WEC starts fulfilling its new mandate and has adequate resources.
- Seventy-five per cent of local projects are planned, implemented and managed by local agencies with competent staff.
- Three major river basin planning units are established and addressing river basin water issues.

By 2027

- Hundred per cent of local projects are satisfactorily planned, implemented and managed by local agencies.
- All major and medium river basin planning units are functioning well by addressing water issues.

Action Programmes:

The IWRM and river basin planning concept will be institutionalized at different levels of water administration. The institutions will be suitably designed to provide smooth transition of command and control from basin-level institutions to local-level institutions in existence, which are based on political boundaries. The focus of the institutional mechanism programme, during the short term, will be to streamline the governance system by restructuring and empowering the central-level institutions, including the WEC. Similarly, focus will be given to empowering and making effective the district-level institutions, including the DWRC.

NEA will be restructured by unbundling it into a number of effective corporatized entities. A separate autonomous rural electrification agency will be established, whereas the electricity sector will be operated in a truly competitive mode with several private sector operators.

WECS will be transformed to WEC, operating full time with a permanent office and with the provision of chief commissioner and commissioners, who will be full-time office bearers. River basin management (RBM) will be established at the basin level. There will be three basin-level offices, Koshi, Narayani and Karnali, which will appropriately cover the area of other medium and small rivers. Similarly, the implementation capacity of local-level institutions will be considerably enhanced in the spirit of decentralization restructuring and strengthening of the DWRC. The action programmes and their key activities are enumerated below:

1. Restructure and activate central planning organization. The key activities are:
   (a) Restructuring and strengthening WEC:
   (i) The existing WECS will be turned into WEC. Thereafter, WEC will be restructured with the provision of a full-time operating Chief Commissioner. Under the chief commissioner there will be two commissioners for two professional fields, ie Water Resources and Energy. The chief commissioner and commissioners will be appointed by HMG from private or public sector and from among professionals meeting certain pre-determined criteria for a fixed period. There will be a secretary responsible for the overall administration, who will also act as member secretary of the commission. There will be a director of Gazetted Class I for each of the four sectors, representing legal and institution; economic; water resources; energy, environment and watershed management. WEC will have RBOs operating at basin level, working under its administrative command. Re-structuring of WEC and establishment of RBOs will be completed by 2007. The secretary and the staff under him or her will form a secretariat to support WEC.
   (ii) Restructure the existing WEC members into a consultative and advisory committee.
   (iii) Provide mandatory authority to WEC through the Transaction of Government Business Rules to coordinate all water-related periodic and annual plans as well as monitor its implementation in an advisory capacity. WEC will be mandated to advise on budget allocation.
   (iv) WEC to provide techno-economic clearance to water resources projects. Techno-economic clearance from WEC will be made mandatory for:
      A. Hydropower projects of more than 10 MW installed capacity;
      B. Irrigation projects of more than 5,000 ha command area;
      C. Drinking water supply projects covering more than 100,000 population;
      D. River training projects covering a river stretch of more than 10 km, irrespective of the protection work being on one or both sides of the river;
      E. Projects designed for multipurpose use;
      F. Projects with trans-boundary implications; and
      G. Projects involving inter-basin water transfer.
   (v) The detailed working procedure and time schedule for techno-economic clearance will be prescribed for ensuring effective coordination. Administrative, advisory and consultative role for WEC will be defined in the working procedure.
   (vi) The RBM will be responsible for allocating water to projects and thereby providing resource clearance.
   (vii) Cabinet Secretariat to be designated as the contact agency of WEC.
   (b) Rationalize the role of the NPC:
   (i) NPC rationalizes its role on water resources sector by integrating the WEC plan and programmes with overall national policy and plans.
   (c) Restructure and strengthen government ministries and departments:
   (i) The government ministries and departments under them will be restructured for the smooth implementation of the NWP. This will be a dynamic process and will be in response to the needs experienced during implementation. It is expected that all related ministries will fine-tune their organizational structure accordingly.

The proposed organizational/functional chart of WEC is presented in Annex 8.

2. Maintain clear separation of roles between policy, operation and regulation. The key activities are:
   (a) Rationalize the roles of different organizations:
   (i) Appoint professionals for the chair and other board members of large-scale water resources-related boards, including that for NEA until it is completely unbundled.
   (b) Rationalize the organizational structure:
   (i) Establish Himalayan Climate Change Study and Research Centre under the DHM.
   (ii) Establish Hydropower Research Centre under the DoED.
   (iii) Establish RBOs at appropriate basin/sub-basin level under WEC and institutionalize them.
   (iv) Set the DHM under the MoWR, and strengthen as well as extend the existing DHM basin offices to meet the RBM requirements.
   (v) Review and restructure DSCWM to implement the environment and watershed management activities.
3. Set up separate regulatory boards for three sub-sectors, viz domestic water supply, groundwater and power.

4. Restructure organizations:
   (a) Unbundle the NEA into different entities, viz generation, transmission and distribution, by amending the NEA Act by 2007 to effectively corporatize them.
   (b) Privatize the unbundled entities with further disintegration, if necessary, in the medium NWP period, ie 2008-2017.
   (c) Establish an autonomous rural electrification agency.
   (d) Restructure the DWRC by replacing CDO with DDC president as the chairperson of the DWRC; amend the Water Resources Act accordingly.
   (e) Make provision for requiring the consent of the RBM concerned for water allocation in the granting of licence by the DWRC.
   (f) Strengthen the DWRC by strengthening the DTO with adequate personnel and resources to enable them to perform their tasks to meet the targets set by the Water Resources Strategy (WRS).

5. Set up institutional framework for coordinated and integrated development at the basin level. The key activities are:

   (a) At central level:
   (i) Streamline and orient the structure of related ministries and departments for the implementation of the NWP and for basin-wide water management.
   (b) At basin level:
   (i) Establish RBOs at basin/sub-basin level.
   (ii) Authorize RBOs to:
      A. Allocate water resources to a new water project.
      B. Acquire information on water resources from various government and non-government agencies.
      C. Acquire and maintain meta data for various uses of water resources within the basin.
      D. Develop and maintain water accounting system for the basin as a whole for water allocation and other planning purposes.
   (iii) Orient water-related offices to provide inputs to RBOs.

(c) At district and sub-basin level:

(i) Strengthen the DWRC and enhance its capacity.

(ii) Encourage the DWRC to set up sub-basin committees to manage all its resources on basin-wise basis under its political and administrative jurisdiction. Constitute district water assembly to support DWRCs and basin committees.

(iii) Orient the DWRCs to the basin management concept and associate them with the RBOs.

The project portfolio for institutional development is presented in Annex 9.

Table 4.11: Estimated Programme Costs for Institutional Mechanisms (NRs millions at 2003/04 price level)

S.N.	**Programmes**	Short Term	Medium Term		Long Term		**NWP (Total)**
		10th Plan	11th Plan	12th Plan	13th Plan	14th Plan	
1	Central Planning	657.6	657.6	548.0	438.4	438.4	**2740.0**
2	Regulatory Agency	1644.0	1644.0	548.0	548.0	328.8	**4712.8**
3	Human Resources Development	68.8	93.7	115.6	57.8	46.9	**382.8**
4	Research Programme	263.0	548.0	822.0	657.6	548.0	**2838.6**
5	Central Institutions	1644.0	1644.0	1644.0	822.0	822.0	**6576.0**
6	Local Government Support	1499.3	2285.2	2285.2	1874.2	1052.2	**8996.0**
7	River Basin Management	438.4	657.6	1096.0	1096.0	548.0	**3836.0**
8	Local Organization	589.6	1107.0	1107.0	1107.0	734.3	**4644.8**
	Total	**6804.8**	**8637.0**	**8165.7**	**6600.9**	**4518.5**	**34727.0**
	Share percentage	19.6	24.9	23.5	19.0	13.0	100.0

Part C. Investment Portfolio and Macro-Economic Implications

5. Economic and Financial Analyses

5.1 Methodological Approach

5.1.1 Identification of cost and benefit

The scenarios of with and without project have been envisaged to arrive at the incremental costs and benefits. For the present estimate of the cost and benefit, the cost and benefit components of the major projects have been upgraded from the available project feasibility reports by making adjustments for both foreign and local inflation. For the projects for which detailed feasibility studies were not available, project costs have been estimated based on the standard norms for similar projects. The manufacturing value index of G5 countries has been considered as the inflation index for adjusting the foreign cost components, while the GDP deflator has been used for adjusting local expenditure parts. The Nepalese rupees equivalent cost has been estimated based on the present (FY 2003/04) exchange rate of US$1=Rs75. The inflation has been assumed to affect both the benefit and cost sides in a similar way.

The assumptions made, model used and the projection parameters considered in the Phase II studies of the WRSF are applied wherever necessary and appropriate in preparing the NWP. Mostly secondary information has been used for additional analysis. A number of institutional heads, WUC members and water users were also consulted to solicit the required primary and semi-primary information. The secondary data used from the WRSF Phase II and I have been updated wherever applicable. The APP, master plan documents in different sectors, feasibility studies, project completion reports, Ninth and Tenth National Plans, Power System Master Plan for Nepal, and NEA and WECS publications are the major sources of information in the study.

5.1.2 Breakdown of Local and Foreign Exchange Components

The total cost has been broken down into local and foreign cost components. Local cost is based on the expenditure projected for the local goods and services. For imports, the foreign exchange equivalent has been evaluated. Similarly, for the possible direct export of some commodities, eg electricity, the foreign exchange earning has been estimated separately. The overall foreign cost components are estimated to be 58% on water supply and sanitation, 75% on hydropower, 35% on irrigation, 20% on fisheries and 25% on the rest of the sectors.

5.1.3 Use of Discounted Approach and Cost–Benefit Analysis

In analysing projects, both financial and economic analyses of cost-benefit and cost-effectiveness have been carried out as appropriate. The criterion of economic and financial profitability or cost-effectiveness analysis such as the benefit-cost ratio (B/C), Net Present Value, Economic Internal Rate of Return (EIRR), Financial Internal Rate of Return (FIRR) and cost-effectiveness was applied as the first gate pass for projects' selection. Once a project fell within the prescribed norm of cost-benefit or cost-effectiveness, the other criteria of project screening were applied to meet different objectives to arrive at the prioritized projects. The selection of

projects included multidisciplinary analysis and also feedback from various workshops. The criterion of cost-effectiveness was applied in the social sector projects such as drinking water and flood control. The cost-benefit criterion has been applied in projects such as hydropower and irrigation. For cost-benefit analysis, cut-off internal rate of return has been fixed at 15% for financial analysis and 10% for economic analysis. In applying cost-effectiveness in the social sector projects, the criterion of remaining within the approved norm has been applied while estimating costs.

5.1.4 Treatment of Price, Transfer and Subsidies and use of Shadow Pricing

Farm gate and economic prices have been taken in the case of marketed commodities. Cost, Insurance and Freight (CIF) prices have been taken for imported commodities and Free on Board (FOB) prices for export. For non-trade commodities, existing market prices have been considered. For analysis, all types of cost breakdown in major headings, including use of foreign and local materials, skilled and unskilled labour, taxes, subsidies, tariff, etc, have been considered and adjusted accordingly for transferring financial cost to economic cost. Similarly, both direct and indirect benefits to be received from the investments in projects/ programmes have been quantified as far as possible. The non-quantifiable benefits and costs are presented in descriptive form. The sustainability of the investments in projects/ programmes is assessed giving due care to their operating life, financial considerations and various other dimensions. The distribution effect of the investments in projects/ programmes, particularly on the poor, is also analysed by distributing the differences of economic and financial gains among stakeholders. For that, the measures of poverty impacting ratios have also been applied. Sensitivity of projects/ programmes has also been undertaken by analysing the risk factors.

5.1.5 Use of Standard Conversion Factor

Foreign cost has been separated by sectors. Non-foreign cost has been converted to foreign exchange equivalent at prevailing exchange rate by using standard conversion factor. The use of the conversion factor is based on the estimates of recent studies. Usually, the shadow price of labour is taken as half (disguised unemployment being about half), but since out-migration of labour is rising fast, the shadow price of labour has been taken a bit high, at 0.67.

5.1.6 Sustainability Analysis

While social and other aspects have been analysed separately, financial analysis has also been carried out for all the schemes to analyse their sustainability. Analysis from the perspective of the corporate body as an individual entity has also been done to look at the sustainability of undertaking the investment by a government entity in some products such as electricity and drinking water.

5.1.7 Evaluation of Benefits

As field assessments were out of the scope of the present study, the norms and results of various studies have been used to arrive at project-specific conclusions. In drinking water, tariff has been taken as the financial benefit of the scheme from sustainability point of view, but the value of time saved has been used as an economic benefit. In electricity, it has been considered as a non-trade good, and the tariff rate has been used for both economic and financial benefit estimation as the formal opportunity cost estimates of electricity for alternative

use are not available. Even if the economic benefit evaluated based on tariff rates is conservative, it still gives good feedback on the sustainability of projects. Cost effectiveness as an alternative tool has also been applied to both drinking water and electricity. In irrigation, the value of the increased crop at farmgate market price has been used for financial benefit and economic prices based on recent studies have been used to evaluate the economic value of benefits.

5.1.8 Treatment of Target and Regional Balance

The projects selected are based on service-providing, cost-benefit and sustainability approach. Given the benefit-cost strength, vision of basic service provision is applied to meet target population to be covered as specified in the NWRS. Regional development being imbalanced in the past, regional distribution of investment and benefit sharing has been given due consideration, except in the projects of national-level common use and impact. Regional distribution of investment and impact has also been analysed.

5.1.9 Treatment of Multipurpose Projects

Multipurpose projects minimize the unit cost of services or products. Such projects have been envisioned in irrigation and hydropower as the country has good potential for them. Four irrigation projects, viz Sunkosi Kamala Diversion, West Rapti, Kankai and Bheri-Babai Diversion, have been taken as multipurpose projects. Bheri-Babai has been considered as a multipurpose project as the water level increase in the Babai River after the construction of a dam on Bheri and the diversion of water to Babai will provide opportunity for extending the Babai Irrigation Canal. In evaluating the cost of multipurpose projects, the common cost of dam is split into both the sectors: 28% to irrigation and 72% to hydropower (based on feasibility study and supporting norms). In case of benefit, they are counted separately in the sector concerned.

5.1.10 Estimated Capital Expenditure

The capital expenditure has been estimated as the sum of: (a) investment, (b) replacement costs (as such items expand the life of the machinery) and (c) capital expenditure items related to O&M. Based on discussions with experts, 10% of the total O&M and non-structural costs have been taken as the capital. The estimate of capital expenditure has been done at the 2001 price for macro analysis. It is estimated to be Rs950 billion over the plan period.

5.2 Sector Approaches in Analysis

5.2.1 Irrigation

The policy taken in irrigation is not to discriminate against the use of alternative sources of water. The present policy of the government differentiates between the sources based on financial ground and not on technical efficiency of money spent and quick results. Surface schemes are considered as public goods, DTW as semi-public goods and STW as private goods, though the use of water for irrigation is common. The cost borne by farmers on the installation varies between 3 and 100% by the category of projects. In surface schemes, the cost borne is about 3 to 5%. It rises to 15% in the case of DTWs and 100% in the case of STWs. The O&M

of surface irrigation is also subsidized mostly with a low irrigation fee of Rs200 per ha (Rs400 per ha in Mahakali). The water charge collected meets less than 10% of the O&M requirement and also the water charge collection is very poor.

Until 1999, the STW installation was subsidized up to 30% and the number of STWs installed had reached 5,000 a year. After the withdrawal of subsidy, the number of STWs installed has dropped to one-tenth, ie around 500 a year. The imbalanced subsidy policy has led to the use of high cost technology of surface schemes in the terai. The surface irrigation cost is about Rs150 thousand per ha as against Rs20 thousand per ha of groundwater. If we consider only the installation of tubewells by allowing farmers to take care of the pump themselves, the cost would be about half. With such groundwater policy, the installation (excluding pumps) can be taken care of by less than Rs5 billion in total (for about 175 thousand STWs) to cover the entire terai under STWs, while the country has been spending about Rs4 to 5 billion a year on surface schemes and only a tiny proportion on groundwater. Rapid installation of STWs as a short-term measure will quickly increase the income in the terai at a small cost and in due course these installations will automatically be converted into conjunctive schemes after surface irrigation is developed. Developing of tubewells by the government as a campaign has been visualized in this study. However, the full cost of STWs has been shown in the study for analytical purpose. Additionally, for integrated use of irrigated agricultural land, Rs1,350 per ha has been proposed as support cost or extension and research in the study.

The policy adopted in the NWP in this context is not to discriminate against sources of water and leave operation responsibility to farmers. What this means is that the installation part of the well in groundwater and the dam and canal construction part in surface schemes are to be borne by the government and water charge levy per ha should be smooth, irrespective of surface scheme or groundwater. At present, the irrigation charge in a publicly constructed scheme is Rs200/ha and it is proposed that this be adopted smoothly for all groundwater and surface schemes. Promoting groundwater fast will also facilitate the conjunctive use of groundwater with surface water to promote year-round irrigation. At present, water availability in dry (winter) season in surface schemes is adequate for less than 50% of the land.

5.2.2 Drinking Water

The policy taken is to first provide drinking water services and then improve the service to address the supply quality and sanitation from the sustainability point of view. The analysis has been done at current tariff rates. The cost-effectiveness approach has been applied to minimize the cost of the service provided. At the same time, the issue of sustainability has also been addressed by applying the cost-benefit approach. Emphasis has been given to community participation in rural water supply for sustainable management. In urban areas, the cost recovery aspect has been analysed at present tariff rates by estimating the financial and economic rates of return.

5.2.3 Hydropower and others

The hydropower programme has been screened based on the cost-effectiveness (within a certain acceptable range) and also the rate of return analysis. The cases of large exports have not been considered as they will mainly be for export and only royalties will enter directly in economic stream and most of the investments will be imported items. From this perspective, the West Seti cost and benefit has been counted for 75 MW bonus projects. In upper Karnali, only

the investment share of the government and the potential revenue have been counted. The costing approach in other sectors is based on the cost-effectiveness and present trend from the country's economic development scenario. The investment in other sectors is less than 5%.

5.3 Portfolio Analysis

5.3.1 Approach to Identification of Projects

Emphasis has been given basically to the following four aspects: (a) target to reach the level of population served in case of drinking water; (b) target to develop desired infrastructure level in irrigation to attain desirable growth in agriculture; (c) target to meet a desired level to meet internal demand by certain year and enhance export; and (d) mitigation level required in case of disaster prevention and environmental damage in case of flood control and other damage from additional water use. For that, the proposed projects have been based on the HMG long-term plan as perceived in the WRS, APP, Tenth Plan and the government commitments made at international communities. However, given the past progress apart from the targets and expenditures of the Tenth Plan have been adjusted.

5.3.2 Project Selection Criteria

The Tenth Plan specifies eight criteria for the selection of projects. The plan, however, offers flexibility for some criteria of sector specific requirements. By remaining within the broader framework of the criteria prescribed by the Plan, the project selection criteria applied in general are based on: (i) meeting the WRS target; (ii) B/C, IRR and/or cost-effectiveness; (iii) contribution to poverty alleviation; (iv) sectoral priority; (v) regional balance; (vi) private sector participation; and (vii) export possibilities.

5.3.3 Investment Portfolio-Public and Private Sector Investment

Long-term investment portfolio from macro perspective has been taken from the WRS for the projected investment requirement during different plan periods. As the level of investment prescribed by the WRS has already been approved by the government, detailed workout of the investment has been done to match the projected investment portfolio. The investment share by public and private sector is based on the recent sectoral policies, Tenth Plan and the water sector strategies approved by the government in 2002. Estimated private sector shares in the WRS are: (a) irrigation: 15%; (b) water supply and sanitation: 16%; (c) hydropower: 70%; (d) disaster prevention: 4%; (e) environment: 4%; (f) fisheries: 76%; and none in the river basin planning and institutional strengthening.

5.4 Project /Programme Selection and Investment

5.4.1 Investment

Overall investment and expenditure by the Plan period has been Rs1,218.9 billion, with 9% in the Tenth Plan, 19% in the Eleventh Plan, 21% in the Twelfth Plan, 24% in the Thirteenth Plan and 27% in the Fourteenth Plan. The estimated capital expenditure is 82% of the total expenditure estimated in the Plan. The total capital investment projected by the NWRS was Rs1,014 billion at 2001 price. The capital investment projected by the NWP at 2001 price is Rs950 billion. Thus, the proposed programmes are within the budgetary envelope approved by the NWRS. Some future potential components prescribed by the Plan, such as water

transportation, tourism and recreation, are not covered for lack of information and supporting studies. Considering these, the NWP investment is within the vicinity of the prescribed framework. In the total investment and expenditure, the share is the highest for hydropower (42%), followed by irrigation (22%), drinking water and sanitation (19%), electrification (11%) and others with less than 5% (Table 5.1).

The project portfolio for overall investment and expenditure for all sectors and the summary of projected capital cost by projects and programmes for the plan period are presented in Annex 10 and 11 respectively.

Table 5.1: Summary of Total Programme and Project Costs of All Water Sub-sectors in the NWP by Plan Period (NRs millions at 2003/04 price level)

S.N.	Programmes/Projects	10th Plan	11th Plan	12th Plan	13th Plan	14th Plan	Overall NWP Total	% Share
A	Drinking Water and Sanitation	29029	42745	48951	53244	57389	**231358**	0.19
1	Structural	28329	41016	46647	50363	54508	**220863**	0.18
	Investment	27876	38860	42468	44029	45940	**199172**	0.16
	O&M	454	2157	4179	6333	8568	**21690**	0.02
	Replacement	0	0	0	0	0	**0**	0.00
2	Non-Structural	700	1729	2305	2881	2881	**10495**	0.01
B	Irrigation	21697	53419	50540	62916	77981	**266553**	0.22
1	Structural	21266	52087	49209	62027	77092	**261680**	0.22
	Investment	18492	38193	25049	29716	42090	**153540**	0.13
	O&M	1575	9538	16837	22015	24135	**74101**	0.06
	Replacement	0	223	1286	2789	3044	**7341**	0.01
	Agricultural Support Service	1199	4134	6036	7507	7823	**26699**	0.02
2	Non-Structural	431	1331	1331	889	889	**4872**	0.00
C	Hydropower	29329	92350	110641	128919	150123	**511362**	0.42
1	Structural	29173	91873	110089	128296	149419	**508851**	0.42
	Investment	29124	89313	103295	116514	131764	**470009**	0.39
	O&M	50	2560	6794	11782	17655	**38841**	0.03
	Replacement	0	0	0	0	0	**0**	0.00
2	Non-Structural	156	477	552	623	704	**2511**	0.00
D	Electrification	12883	12353	12353	21328	21328	**122782**	0.11
1	Grid Expansion	8264	10136	10136	16894	16894	**62324**	0.05
2	Small and Micro Hydro	4618	2217	2217	4434	4434	**17922**	0.01
3	System reinforcement	4846	8846	9230	9615	10000	**42537**	0.04
E	Disaster Management	5264	6800	10046	6631	6297	**35038**	0.03
F	Environment	2560	1778	1699	1653	1647	**9337**	0.01
G	Fisheries and Other Water Uses	841	1652	1652	1609	1609	**7363**	0.01
H	River Basin Planning	204	99	99	8	8	**418**	0.00
I.	Institutional	6805	8637	8166	6601	4519	**34727**	0.03
All	Grand Total	**113458**	**228679**	**253378**	**292524**	**320901**	**1218938**	1.00
	Share of Each Periodic Plan	0.09	0.19	0.21	0.24	0.27	1.00	

5.4.2 Investment Breakdown By Sub-sector Programmes

5.4.2.1 Drinking water

This programme embraces four different kinds of programme on water supply and sanitation: (i) rural, (ii) small town, (iii) Kathmandu valley water supply and (iv) major town. Some support programmes on human resource development, environment and quality aspects

have also been proposed. While all rural and urban areas are to be covered by the water supply by the end of the Plan period, service improvement is to be provided for 50% of the population. The Yangri scheme has also been proposed to be joined to Melamchi to meet the future water demand in Kathmandu. The total cost of the programme is Rs231 billion, with an investment of Rs199 billion during the Plan period.

5.4.2.2 Irrigation

The major investments are to be made in groundwater, minor and big surface irrigation, rehabilitation and multipurpose projects. The total programme cost is Rs267 billion, whereas the investment is Rs154 billion. The total area to be covered over the Plan period is 600 thousand ha. Emphasis has been given to groundwater development in the terai. Most of the groundwater in the terai is to be covered by the Twelfth Plan period. Thus, groundwater investment is more concentrated in the Eleventh and Twelfth Plan periods.

5.4.2.3 Agriculture Support

Agriculture support has been tied to irrigation as an integral part of the overall agricultural development. An amount of Rs1,350 per ha has been earmarked for the extension and research support. This comes to about 7-10% of the gross return and is expected to be about 100% more than the present level in the irrigated land.

5.4.2.4 Hydropower

Of the altogether thirty-one projects covered, three will be completed after the NWP. The total programme cost is Rs511 billion with investments of Rs470 billion over the Plan period.

5.4.2.5 Electrification

The micro hydro, rural transmission and system enforcement are covered to enhance rural electrification. The total programme cost over the Plan period is Rs123 billion.

5.4.2.6 Other Uses of Water

Investments are being made in eco-tourism, rafting and mineral water by the private sector. Water transportation may also be possible in the future. Detailed information is however lacking. Some more exploration is needed in this area.

5.4.2.7 Fisheries

Fisheries development is an integral part of the effective water use. Only a small section of the water body is being utilized for this purpose at present. Focus has been laid on fisheries development and pond construction. Private sector investment has gradually been increasing in this area. Agricultural Development Bank-Nepal (ADBN) has been supporting this programme through credit. The total programme cost over the period is Rs7.3 billion.

5.4.2.8 Disaster Management

It addresses the key areas relevant to conservation in the irrigation and hydropower sector. The programmes identified in the sector are: (i) water-related disaster management policy

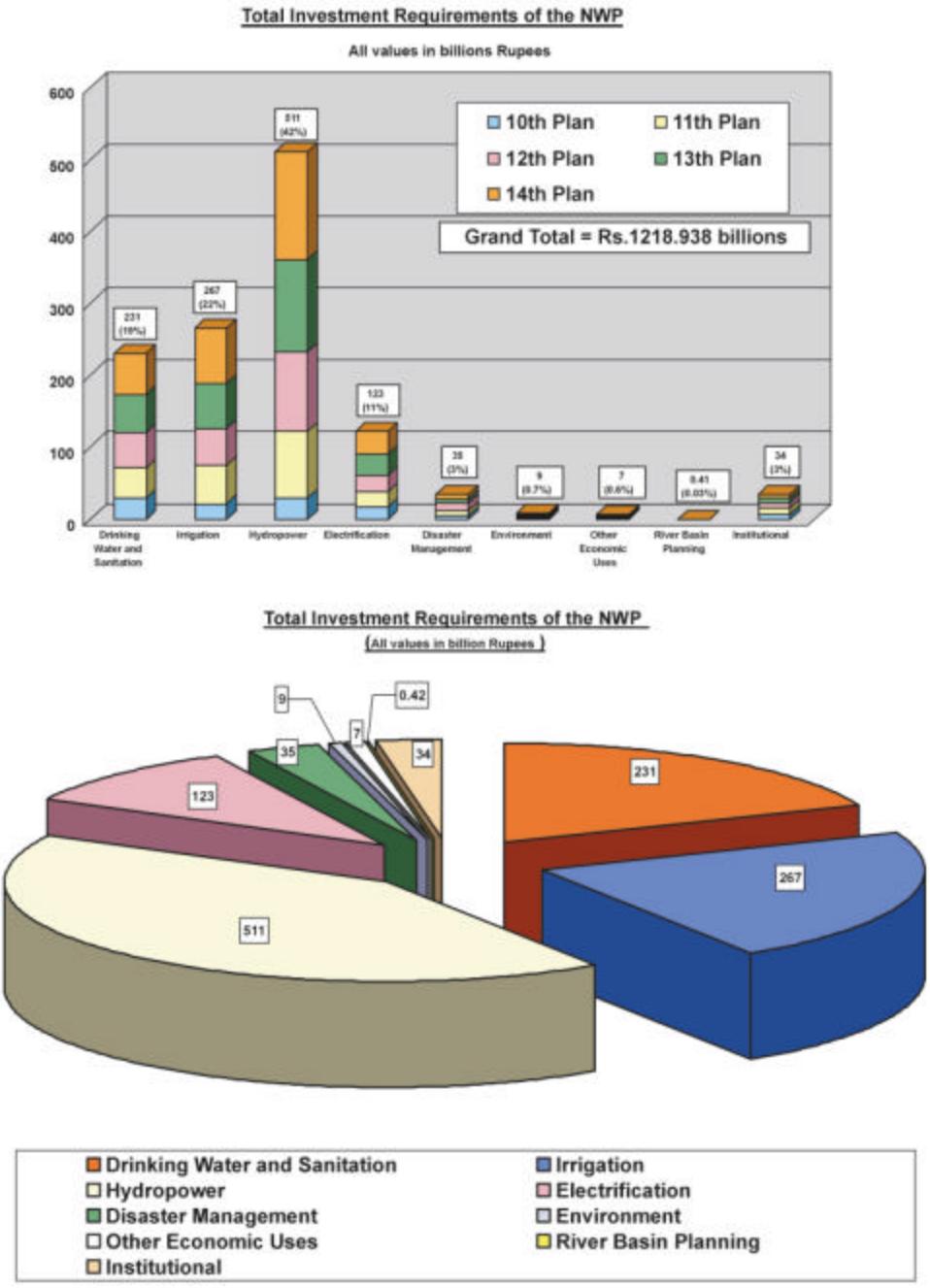

Plate 13: Total Investment for NWP

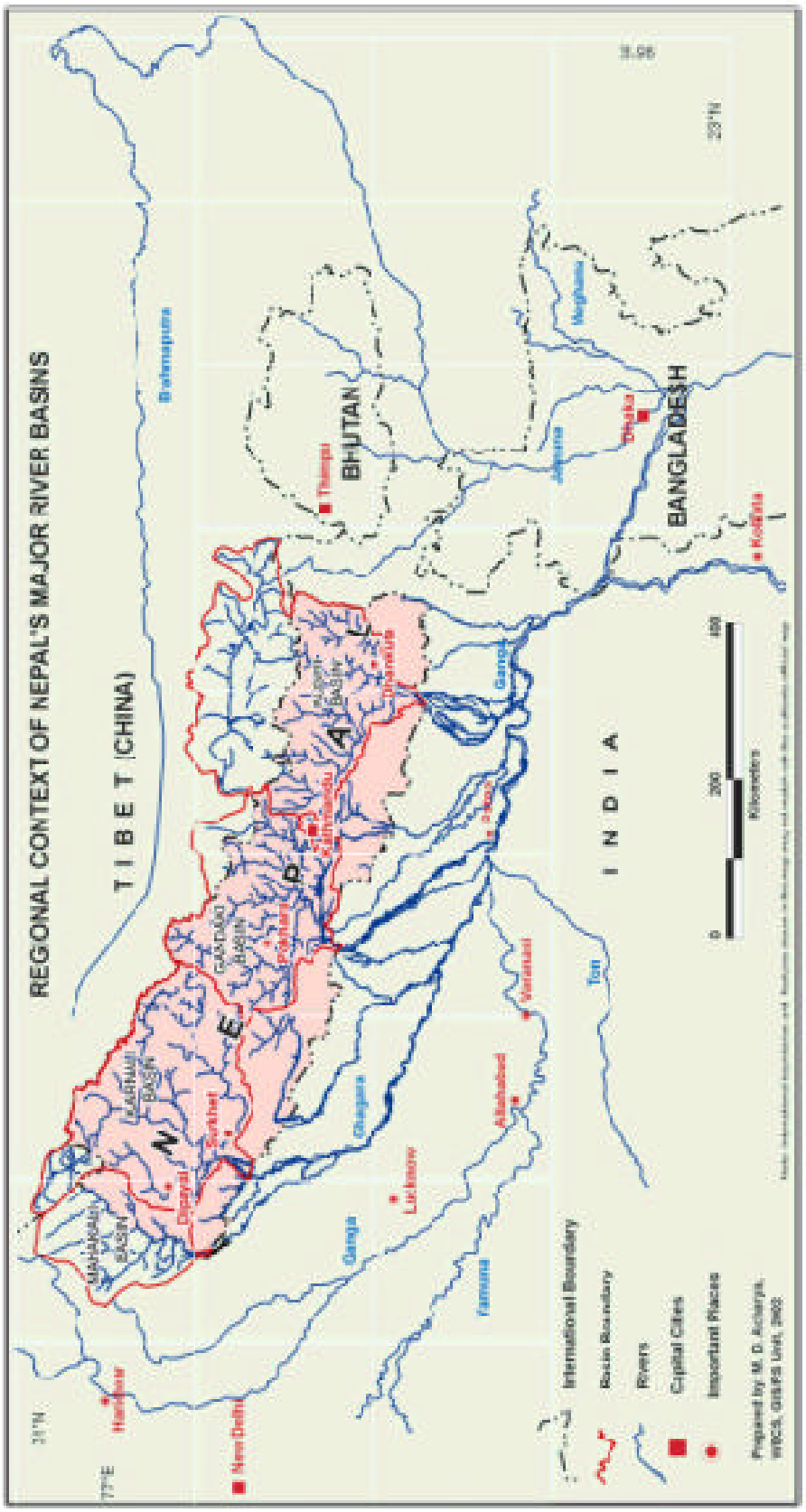

Plate 14: Regional Context of Nepal's Major River Basins

and programme; (ii) risk/vulnerability mapping and zoning programme; (iii) disaster networking and information; (iv) disaster preparedness plan (v) relief/rehabilitation; (vi) inundation committee activation; (vi) flood/drought, landslides/GLOF management; (vii) watershed management of rivers; and (vii) O&M. The total programme cost over the NWP period is Rs35 billion.

5.4.2.9 Environment Management

Environment management consists of the programme related to database strengthening, awareness programmes, ecosystem protection and community participation promotion. The total programme cost over the NWP period is Rs9.4 billion.

5.4.2.10 River Basin Planning

River basin approaches, being a newly introduced concept in water resources management in Nepal, institutional building, basin-wise planning and information strengthening are important aspects to be addressed. Allocation has been made accordingly. The total programme cost over the Plan period is Rs418 million.

5.4.2.11 Institutional Development

Institutional strengthening is important in all sub-sectors as the implementation capacity needs to be enhanced for the effective implementation of the NWP. In this context, in addition to central-level capacity enhancement, local governments and organizations should also be strengthened. Allocation has been made accordingly in the Plan. The total programme cost over the Plan period is Rs34.7 billion.

5.5 Foreign Exchange Cost in Water Plan

The total foreign exchange demand in the NWP is Rs702 billion (US$9.4 billion). The foreign exchange cost is 61% of the total investment. The average foreign exchange cost per year in the Tenth Plan is Rs12.9 billion and the average foreign exchange cost per year in the NWP is Rs28.0 billion (For details, see Table 5.2).

Table 5.2: Foreign Exchange Cost (in NRs million at 2003/04 price)

Foreign Exchange/Plan Period	Short Term	Medium Term		Long term		**NWP Total**
	10th Plan	11th Plan	12th Plan	13th Plan	14th Plan	
Total Foreign Exchange	64365.2	133314.6	145858.4	168623.1	189355.1	**701516.4**
Capital	61781.0	127388.4	137023.5	157405.5	176371.1	**659969.4**
Others	2584.2	5926.2	8835.0	11217.6	12984.0	**41547.0**
Foreign Exchange Cost Proportions						
Foreign exchange % in capital cost	66.6	68.4	69.9	70.6	70.0	**69.5**
Foreign exchange % in other cost	18.4	19.6	20.2	20.7	21.2	**20.4**
Foreign exchange % in total cost	60.2	61.6	60.8	60.9	60.4	**60.8**

5.6 Sectoral Return Analysis

5.6.1 Rate of Return Analysis

Estimating the rate of return for individual projects was beyond the scope of the study as field surveys were not included in the study. For that purpose, several previous and recent studies were used as background materials for reviewing the rate of return. Some of the studies

being old and tax structure having changed, financial rate of return was estimated separately. Economic rate of return having been estimated for the adjusted prices of both input and output to represent the free market, rates of return are not likely to change significantly.

5.6.2 Drinking Water

Overall financial and economic rates of return of the DWSSP (RWSSP, STWSSP, MTWSSP and KVWSSP) have been estimated. The FIRR and EIRR are 16% and 17% respectively. The B/C in Net Present Value (NPV) in financial terms is 1.41 and 1.54 respectively. Sensitivity analysis at 10% of the cost also makes the IRR attractive. The sensitivity test indicated that the projects were less sensitive to increase in costs as well as decrease in benefit. The variations in FIRR and EIRR were about 4% to 6% in both cases with 10% rise in cost. The individual FIRR and EIRR have been estimated as follows.

Table 5.3: Estimated Financial and Economic Parameters of Drinking Water and Sanitation Projects Proposed in NWP (NRs millions at 2001 price level)

ID No.	Names of Projects	Financial				Economic				PIR (Poverty Impacting Ratio)
		FIRR	B/C Ratio	Total Benefit	Net Benefit	EIRR	B/C Ratio	Total Benefit	Net Benefit	
1	Rural Water Supply and Sanitation Project	38%	2.52	31 301.61	18 886.44	46%	2.75	28 171.45	17 928.94	50%
2	Small Town Water Supply and Sanitation Project	23%	1.45	13 597.63	4 200.81	27%	1.58	12 237.86	4 485.49	48%
3	Major Town Water Supply and Sanitation Project	20%	1.38	8 036.67	2 232.93	24%	1.51	7 233.00	2 444.92	48%
4	Kathmandu Valley Water Supply and Sanitation Project	5%	0.62	13 175.10	-8 127.60	5%	0.67	11 857.59	-5717.14	50%

5.6.3 Irrigation

The present investment strategy is based on developing year-round irrigation in additional 600,000 ha during the NWP period. There are forty-two irrigation projects under the portfolio for the hill and terai areas. The aggregate irrigation area developed under each plan period is based on the irrigated land for crop production required to maintain the country's food security. Irrigation development by private sector is estimated to be one-third. Community participation has been emphasized. Cost and benefit-sharing between government and WUC has been specified by the irrigation by-laws. All investment and operating costs on shallow tubewells have to be borne by farmers. However, the electricity tariff for irrigation has been subsidized up to 50%. In case of surface schemes, the water charge ranges between Rs200/ha and Rs400/ha.

The rate of return and cost-benefit ratio of major schemes are reported in Table 5.4. The EIRR of most of the schemes is reasonably good. The FIRR is somewhat low due to market imperfections of different types. The estimated EIRR is the highest in micro irrigation systems. The lowest EIRR is observed in surface irrigation systems. Rehabilitation projects naturally have higher EIRRs than newly constructed projects. The overall FIRR and EIRR are 15% and 22% respectively. Similarly, financial B/C is 1.26 and the economic B/C is 1.48. The sensitivity analysis, assuming 10% reduction in benefit and increase in costs, sometimes might result due to cost overrun and uncertainty of yield and crop price. The test exhibited just a marginal decrease in the EIRR.

Table 5.4: B/C, FIRR and EIRR

ID No.	Project Status	B/C Ratio at 12%		FIRR	EIRR
		Financial	Economic		
Hill					
New	New	0.63-2.06	0.77-2.01	6-21%	8-21%
Major Rehabilitation	Major Rehabilitation	1.52-5	1.72-4	16-42%	18-39%
Minor Rehabilitation	Minor Rehabilitation	1.33-1.38	1.31-1.82	15%	14-19%
Terai					
New Surface	New	0.51-1.09	0.66-2.49	3-18%	6-25%
Major Rehabilitation	Major Rehabilitation	0.83-2.2	1.05-2.78	7-34%	11-31%
Minor Rehabilitation	Minor Rehabilitation	1.30-1.92	1.44-3.11	14-21%	15-31%
New GW					
STW	STW New	1.26-1.53	1.95-2.34	16-22%	29-33%
DTW	DTW-New	1.38-1.39	2.22-2.99	18-20%	26-28%
GW Conjunctive	DTW/STW Conjunctive	0.93-1.12	1.33-1.51	8-14%	18-24%
DTW Rehabilitation		5.04	8.09	37%	48%
Micro-Irrigation Project-New		3.46-9.83	4.47-8.95	38-127%	47-120%
Overall		1.26	1.48	15	20

5.6.4 Hydropower Sub-sector

At present, the government, through re-lending to NEA, is the major source of finance in the investment of hydropower projects. Private sector investments are increasing, but, at present, they contribute to only about 21% of the total installed capacity. Most of the government sources are external (77%). The present re-lending of soft loans by HMG to NEA is at 10.25%. The rate applied does not follow variable rate lending and, because of this also NEA has been financially stressed due to the high interest rate. The interest rate to NEA is at par with short- to medium-term commercial rate, somewhat unpalatable to long-term investment in view of the commercial interest rate at present.

Demand for electricity is supply driven and more than 60% of the population is still not served by electricity. The demand forecast is very mixed and varies by studies. Power Sector Master Plan base case scenario and recent load forecast by NEA up to 2020 are both closer, and thus this study uses the master plan base case scenario for future demand forecast for electricity. The long-term growth is about 7.4% per year. Thus, electricity production in excess of that growth can be available for export. With the proposed schemes, the export will be of about 100 MW by 2012, 450 MW by 2017 and 700 MW by 2027.

Table 5.5: Electricity Demand Forecast (MW)

Year	Demand (MW)	Electricity Production (MW)	Export (MW)
2002	449	527.5	78.5
2007	667.1	641.5	-25.6
2012	960.1	1076.6	116.5
2017	1355.4	1794.6	439.2
2022	1894.6	2480	585.4
2027	2661.4	3345	683.6

Of the altogether thirty-two selected projects, four are multipurpose projects; twenty-nine are to be completed within the Plan period. The selection of projects is based on the following criteria: (i) low specific energy costs; (ii) higher level of study; (iii) power purchase agreement (PPA) signed; (iv) generation licence issued; and (v) environmental considerations.

Most of the hydropower project feasibility studies have excluded the taxes and duties in estimating the investment cost as it would be convenient to adjust it to financial cost parameters at different tax regimes. The estimated development cost ranges between US$1,000/KW and US$3,000/KW. The average cost of multipurpose projects, for which 78% of the common cost has been charged to hydropower projects, is US$1650/KW. Most of the hydropower projects involve the construction of some access roads. Such cost involves between 2 and 7% of the total cost and a typical average is 5%. In countries with poor road network, such as Nepal, roads have multipurpose uses, as is seen in other projects. Thus, if half of the road cost is charged to hydropower projects, the typical cost of electricity generation in the proposed projects comes to be about US$1,600/KW.

The overall FIRR and EIRR estimated are as high as 13%. Similarly, financial B/C is 1.30 and economic B/C is 1.32. Though very crude, the estimate for EIRR has also been attempted based on the old information from feasibility studies on total cost, most of which are likely to change significantly. In the projects for which feasibility studies are not available, the norms of similar projects have been used to calculate the cost, whereas the benefit stream is based on the project capacity. The EIRR estimate ranged from 7 to 23%. The highest EIRR is estimated for the Sarada-Babai Hydropower Project and the least for the West Rapti project. Only three projects, viz West Rapti, Dudh Koshi and Kankai, have EIRR below 10%. The lower rates of returns in multipurpose projects, viz West Rapti and Kankai, are also due to high charge (72%) of common cost to hydropower. In Dudh Kosi, a 45 km road (about 2% of the total cost) is to be constructed, which would have several spillover effects, and it, being a storage project, has an additional merit of maintaining regular power supply; thus, the EIRR of 7% in such projects can be considered reasonable. Overall, the projects are attractive from the EIRR point of view. The projects are generally less sensitive with both benefit reduction and cost escalation by 10%; however, the relative impact is higher in price or output reduction.

Table 5.6: Rate of Return of Various Hydropower Projects Proposed in the NWP

Number of Projects	EIRR%	B/C at 10%
5	16 or above	>1.7
8	13-16	1.3 t0 1.7
9	10- 13	1 to 1.2
4	7 -10	0.7 to 1
0	<7	<0.7
Total 26	7-23	0.7 to 2.38
Micro Hydro (< 10 MW)	1- 12%	

Note: additional three projects to be completed after the NWP; Appraisal Report on Nepal Power Development Project, WB 2003.

The reviews of rate of return of other recently completed studies also show results close to the above estimates. In small/micro hydro projects, the EIRR under power development fund, for which feasibility studies have been completed, are found to be in the range of 10 to 33%. Micro hydro projects (less than 1.0 MW) and village electrification components have estimated the average EIRR of 10 to over 12% by taking the economic benefit as avoided cost of kerosene for household and cost of diesel generation for productive purposes. The EIRR of the NEA system expansion plan (between 2002 and 2007) is estimated at 14.3%. The FIRR, on the other hand, is 15 to 17% for small hydro and 10 to 14% for micro-hydro projects. Sensitivity analyses indicate that projects are more sensitive to output. A 10% change in cost will change the EIRR by 0.2%, whereas a 10% change in output will change the EIRR by 2.5% (Appraisal Report on Nepal Power Development Project, WB 2003).

5.7 Poverty Analysis, Regional Balance and Employment

Poverty analysis has been done by taking the poverty index of different districts. A project falling in a particular category of districts is assumed to benefit the percentages of the poor living in the district as estimated from the poverty analysis. For various projects the poverty impacting ratio has been applied.

The analysis of percentage poverty and regional balance has been done with respect to the distribution of project sites. Both investment and employment during construction have been counted. Also, the poverty impacting ratios have been reviewed. In electricity, the proportion of households electrified by the Plan will be 60%. The distribution is to occur in a balanced approach. However, the investment in hydropower will all be in the hill region, with the eastern region having a share of 47%, the central region 10.1%, the western region 6.6%, the mid western region 10% and the far western region 26.3%. Thus, hydropower investment will bring about substantial benefits in the far western and adjoining mid western regions by creating substantial employment during construction. In drinking water, all the population is to receive it and sanitation will be advanced in a balanced way in all the regions. In irrigation, 74% of the investments will occur in the hills and 26% in the terai.

Additional direct employment generation of unskilled labour during the plan period is expected to be equivalent to 5% of the total cost in hydropower. Hydropower and drinking water create 1.4 million person years of additional employment, ie 56 thousand persons per year in hydropower and 14 thousand persons per year in drinking water. In irrigation, employment is to be generated from both construction and increased demand for labour in more intensive farming. Further, employment during construction is estimated to be 44,000 persons year or 1,760 persons year per year. In farm annual employment generation from intensive cultivation, taking a conservative estimate of additional 75 person days per ha from rehabilitation and 150 person days per ha from new schemes, a total of 258 thousand person years per year of direct employment is to be added at full stage. However, the indirect impact of the above growth in employment will be much higher, as indicated in the macro analysis.

5.8 Environmental Aspect

Environmental damage is expected to occur from hydropower dam and intake construction, effects on aqua system downstream due to river blockades, siltation, along with irrigation, water-induced and other natural disasters, etc. Also, from excessive use of groundwater, the groundwater reserve is likely to fall, leading to increase in groundwater salinity. It has been assumed that adequate measures will be taken to mitigate those effects as a built-in approach in the projects itself. For example, regarding downstream effect of dams, aquatic system approach will be followed. For that, 10 to 15% of the water will be released in the river itself, not to affect the aquatic system adversely. Similarly, bio-engineering and silt filtration will be a built-in part of the irrigation dam construction. In the case of groundwater, a prudent policy of limit to shallow pumps per unit area for water pumping and the protection of Churiya range will be applied. For major projects, EIA needs to be done with appropriate mitigation measures.

5.9 Affordability

In drinking water and irrigation sub-sectors, the present policy of transferring completed projects to communities and involving beneficiaries in new projects should be implemented

more speedily along with complementary measures such as affordable tariff rates, capacity building of WUCs, public awareness creation of water as an economic good and enforcement of legal provision for penalizing defaulters. In the case of urban water supply and electricity, the leakage (40% of water supply and 23% of electricity generation) should be addressed adequately and effectively. Similarly, drinking water supply has been deteriorating due to low pricing, hampering adequate supply in the future. At present, given the low rate of return of 5%, the drinking water supply in the Kathmandu valley is not sustainable. In irrigation, water tariff is low and covers less than 10% of the O&M cost. As the actual water tariff collected is very poor, the O&M of water supply is poor, threatening the overall sustainability of the system built with long-term loans, claiming the future generation resources.

Pricing policy across sectors varies with flickering rational of differentiation between policies. The actual rate of return in drinking water is less than 5% in urban areas, which means that it is 50% subsidized even in urban areas. In Nepal, the traditional accounting approach to costing is used and pricing of water is usually linked to the cost recovery of producing a product or service. Irrigation charge is targeted mainly at O&M, let alone cost recovery. Irrigation water from surface scheme and DTW is almost fully subsidized, DTW gets subsidy up to 80%, while STW does not get any subsidy. The cheapest source of water is STW, which, therefore, needs to be pushed from economic point of view. On the other hand, electricity prices are fixed to cover the investment needs for the future expansion of electricity services. Water pricing should be made from both producers and consumers' perspectives. In order to provide reasonable and reliable services, prices of electricity, water supply and irrigation should be closely examined.

In drinking water, users currently pay tariffs based on the O&M costs of water supply and sanitation schemes. In rural water supply, communities currently manage a large percentage of schemes so far as operating costs are concerned, but there is no collection of funds for major repair or rehabilitation. Consequently, the sustainability of many schemes is in doubt without continued capital investments from central agencies. Similarly, in urban water supply schemes, tariffs barely cover the O&M costs. If schemes are to be sustainable, tariffs will have to increase significantly to cover capital costs and depreciation. The current water and sanitation tariff in urban areas is equivalent to Rs18 per cubic metre up to 10 cubic metre. Water bill less than 3% of household income is considered affordable. Average water bill in urban Nepal at present is less than 2% of urban household income. In rural areas, it is estimated to be less than 1%.

In irrigation, for most projects, the irrigation service fee (ISF) is quite below the affordability level. The general water charge is NRs200/ha. In Mahakali Irrigation Project, it is NRs400/ha, which accounts for only 1.43% of the net benefit. ISF below 5% of the incremental benefit is considered as affordable by international norms. From this perspective, the water charge is considered low.

In electricity, consumer number growth during the Ninth Plan was 11.2% a year, whereas the consumption growth of electricity was 12% a year. Consumption is directly supply driven; demand growth among old consumers is slow, at less than 1% per year. Tariff varies from Rs5.50 to Rs9.90 per KWh, depending upon use. For household use, it is Rs4.00 upto 20 KWh per month to Rs9.90 for large users. The tariff is Rs7.30/KWh for per month consumption of 21 to 250 KWh.

The electricity sub-sector has been moving close to full cost recovery for the past five years. As a result, tariffs have risen significantly. Urban household income is Rs97,500 per year at

2001 price. A typical household consumes 50 KWh/month accounting Rs3,600/year. Tariff payment is about 3.5% of household income, which is lower than the affordability norm of 5% for urban areas. The total rural consumption per household (goods and services) being Rs64,000, the tariff stands at about 5% of the household consumption and little lower than 5% of household income. Thus, the tariff rate for rural areas is already approaching the affordability limit.

Nepal's present electricity tariff is considered comparatively high in the region. In 2000, the average tariff in Nepal was NRs6.50 per kWh (US$0.088 per kWh), among the highest in the developing countries in Asia. The marginal rate for domestic energy consumption above 250 kWh/month is NRs9.25 per kWh (US$0.125 per kWh), which is higher than the tariffs of many developed countries. NEA has been purchasing power from IPPs at a rate higher than the current average cost, on the one hand, and the rural electricity coverage is under a tariff structure below the supply costs of power, on the other. This would adversely affect the NEA cost recovery capacity unless it reduces non-technical losses and eliminates high account receivables to lower the unit cost. While there are many low-cost small schemes available in the country, identification of right schemes, introducing more private investments to increase operating efficiency and balancing the external capital negotiation are the main constraints at present. One way of reducing costs would also be to use local expert and financing mechanism for the feasibility and construction of hydropower plants in Nepal. Also, the leakage has to be controlled.

5.10 Financing Mechanism for Water Sector Development

5.10.1 Public and Private Sector Investment

Private sector role will be extensive in investment, planning, implementation, operation, data collection and research. Particularly in hydropower, drinking water and irrigation, there is large possibility of public as well as private investments. Corresponding to the identified involvement, the investment has been separated in the HMG and private sector components. The resource estimate is also backed up by macro analysis. In the water plan, approximately 38.5% of the total required investments are expected to come from the private sector (Table 5.7).

Table 5.7: Composition of Financing in Water Sub-sector Investment Projects Proposed in NWP (In NRs billion at 2003/04 price level)

	Private	%	Government	%	Total	%
A. Water supply & sanitation	37.02	16.00	194.38	84.00	231.40	100.00
B. Irrigation	39.98	15.00	226.57	85.00	266.50	100.00
C. Hydropower sub-sector	357.95	70.00	153.41	30.00	511.36	100.00
Rural electrification	22.56	20.00	90.22	80.00	112.78	100.00
D. Disaster prevention	1.40	4.00	33.64	96.00	35.04	100.00
E. Environmental programmes	0.37	4.00	8.97	96.00	9.30	100.00
F. Fisheries	5.59	76.00	1.77	24.00	7.36	100.00
H. River basin	0.00	0.00	0.42	100.00	0.42	100.00
I. Institutional strengthening	0.00	0.00	34.72	100.00	34.72	100.00
J. The total capital Investment	464.87	38.45	752.06	61.55	1218.93	100.00

With the government's liberal policy of encouraging private investment and sector policies in place, the share of private sector investment is expected to increase compared to the

proportion (26%) projected in the WRS 2002. The estimates are based also on the cost structure of the project, the Tenth Plan projection and policies, and future potential of attracting private investment in a sector. The private sector investments could occur in various forms such as: (a) direct investments by private sector, (b) community contribution and (c) investments by local institutions from their own resources. Lending to local institutions such as municipalities for implementing projects is also a likely scenario in the future, but it has been accounted under public sector, as the resource will have to be arranged by the government.

The private sector share is expected to increase fast in hydropower, as the government policy is to reduce its involvement in generation part. The Tenth Plan projects the private share in the sector to be about 63%. It is expected that this will rise to about 70%, on average, over the NWP period if a modest 3 percentage point increase could be achieved every five years. In rural electrification, the community participation is expected to be 20% with the execution of the present policy.

In drinking water, 20% is to be contributed by the community to the rural water supply. Also, in small and major town water supply, the policy of initial community contribution is 20% (though part of the total cost 30% would be a loan to be recovered later). Sanitation programmes include mostly awareness building and are combined with water supply programmes. Thus, private sector share in water supply and sanitation outside the Kathmandu valley over the Plan period is expected to be around 20%. However, including Melamchi water supply scheme to Kathmandu (a large project), which does not include direct community contribution, the private contribution to the water supply sector is expected to be about 16%.

In irrigation, the private sector share at present is about 14%. In surface schemes, it ranges around 10%. With the emphasis on groundwater under NWP, the share is expected to increase to 17% by the Twelfth Plan period and will fall thereafter. The average is expected to be about 15%. In other programmes such as disaster prevention and environment, community participation in construction activities varies around 10%. However, as none of the proposed programmes requires community participation, the private sector contribution is expected to be 4% in both components. In fisheries, it is taken to be 76%, as in the NWRS. In institutional development, including river basin planning, all costs are to be borne by the public sector.

Although statistics on private sector and community contributions to capital investment and operating costs are not well documented, there is clearly an increasing shift away from the reliance on the public sector in hydropower. Private sector has contributed almost 55% of the capital investment during the last five years, basically in the form of foreign equities and loans (WRS 2002). In hydropower, even if private sector contribution is expected to be large, the public sector investment will be huge and needs to be provided with significant donor support.

In irrigation, capital investment of private sector in tubewell installation under various programmes has also been on the rise in the past, but the private share in the sector is still small with heavy reliance on public sector. So, is the case in drinking water, though industries, hotels and foreign missions have been operating private tubewells for many years.

To implement the NWP, HMG commitment to meeting the investment level is required. So far as overall resource affordability is concerned, the capital expenditure proposed will have to reach 52 billion a year from about 23 billion a year in twenty-five years at 2001 prices. This

accounts for less than 4% real growth in capital expenditure in the sector. If private sector can be attracted more, the burden on the government can be reduced. However, the policy of reasonable cost recovery must be adopted for this and for the sustainable development of the sector.

The funding required for the activities, including environmental protection, water-induced disaster prevention, river basin planning and data collection, should also get priority even if they represent only about 6% of the total cost. They will contribute substantially to the efficacy and sustainability of programmes.

5.10.2 Viable Cost-sharing Mechanism

The technical sustainability of the proposed water resource schemes will depend upon the reasonable cost recovery or the provision of significantly high budgets for subsidizing the recurring and rehabilitation costs in the water sector.

5.10.2.1 Drinking Water and Sanitation

Nepal has accepted that workable mechanisms for cost sharing must be implemented and followed to:

- maintain the existing water supply schemes; and
- ensure financing for the expansion, rehabilitation and improvement of water supply schemes.

The cost-sharing mechanisms for different schemes are suggested as follows.

(a) Rural Water Supply:

The cost of operating and maintaining these schemes should rest with users. A mechanism has been established that allows rural users to contribute part (ie about 20%) of the capital costs and full payment of the O&M costs. This mechanism, based on cost-sharing rather than cost recovery, is more appropriate in rural areas and helps to strike a balance between social equity and economic efficiency. Over time, rural users will have to contribute a higher percentage of capital costs to have their schemes improved or rehabilitated. The average contribution required per household per month to cover the operation cost of rural water supply ranges from NRs8.16 to NRs11.85 for the gravity system and NRs23.21 for a pumped system in 1998.

(b) Urban Water Supply:

The investment required to maintain, expand and improve the quality of service for urban water supply will be very large and will greatly exceed the government's ability to finance unless the level of cost recovery improves significantly. The tariff increases should be linked directly to improved levels of service, which in turn will require some initial investment.

At present, urban schemes are poorly managed and billing and collection systems are weak. Therefore, improvements in cost recovery should be closely linked to the strengthening of management agencies. This can be done by reforming the management practices of the NWSC and municipalities or by service contract to the private sector. Once urban water supply management is fully established and operational, full cost recovery (ie capital and O&M costs) will be possible and must be achieved to maintain and enhance service levels on a sustainable basis. However, the present high leakage up to 40% must be controlled by improving management.

(c) Rural Sanitation:

In rural areas, the aim is to provide basic sanitation to households by constructing latrines. Some existing programmes provide capital subsidy to build latrines but over time, as awareness increases and habits change, it is expected that people will undertake construction themselves. The cost of constructing pour flush latrines may need partial subsidy in the next ten years to encourage their wide use. Government should also invest in latrines in schools, health centres and public places.

(d) Urban Sewerage and Wastewater Treatment:

Investment need for urban sewerage and wastewater treatment is greater than that for urban water supply. The current level of service being offered in sanitation is either very poor or non-existent, as the existing systems cannot deal with the volume of sewage and wastewater that is being generated. Hence, quality drainage and wastewater treatment facilities are needed. Prior to setting up the necessary infrastructure and management systems, a mechanism for full cost recovery of O&M has to be implemented. One way of accomplishing this is to include such a mechanism in water tariffs, as is currently done in Kathmandu.

(e) Point Source Polluters:

The delivery of water to industrial users has to be priced on the basis of its economic value and the associated costs need to be fully recovered. Furthermore, tariffs for industrial users should be directly related to the cost of providing the required quality of service and wastewater treatment. There is also a need for effluent standards enforcement and a revision of the tariff structure for industrial consumers.

5.10.2.2 Irrigation

With the removal of capital subsidies on STW, HMG has already moved in the direction of full cost recovery for groundwater irrigation. A concern remains regarding whether this policy will enable sufficient new investments to meet planning targets. There should be non-discriminatory policy towards the sources of water use for irrigation.

Surface schemes and DTW groundwater schemes are heavily subsidized. WUAs have been formed to help recover the O&M costs, but no effort has been made to recover the capital costs of these schemes. If HMG is going to continue supporting large surface water schemes, it will have to realize more revenue from project beneficiaries and continue allocating a significant amount of central tax revenue to repay loans for these projects. Collecting funds from the beneficiary will help extend the schemes to non-beneficiary poor farmers. Also, in the case of the terai, the priority should shift towards installation of tubewells on government financing and farmers should be allowed to manage pumpsets on their own through bank loans. Even if a farmer cannot purchase a pumpset, he or she can always hire one from those who have bought it. Additionally, large irrigation projects that cannot be well managed by communities could be contracted to the private sector for improving the operating efficiency, reliability of services and efficient collection of ISF. MoWR should take initiation in this direction.

One aspect of sustainability that must be addressed immediately is the need for the ongoing O&M costs to be paid from the increased incomes that farmers realize following the development of irrigation projects. For STW irrigation, those costs are paid directly by individual operators. For community irrigation projects, DTW projects and surface irrigation projects, an

irrigation service tariff must be charged to collect the funds needed for the O&M. For this, WUCs must be strengthened and empowered.

5.10.2.3 Hydropower

Approach of consortium investment and bringing private sector investment in other forms should be applied to lessen the burden of HMG. However, as the investment requirements in hydropower sector in the future is extremely high, the country alone, even including the public and private sector, will not be in a position to finance such a large investment programme. Until recently, 80% of the investments in hydropower generation were funded through multilateral and bilateral donor assistance. However, there exists limitation for the multilateral lending agencies for a single large funding to a small country like Nepal. So, foreign and multinational investments also need to be attracted. However, for such endeavours the existing Acts and Regulations on hydropower need to be improved.

Nepal's capabilities of financing should also be increased through focus on the related industrial sector development with a long-term vision. Energy-intensive industries and electric transport should play a vital role in the future for hydropower consumption inside the country. Hence, Nepal's development planning should be focused on the development of these sectors to promote the financing capacity of the government. Additionally, a rural electrification fund should be created for providing financial support for rural electrification projects. Some of the sources for financing rural electrification could be: money raised through 20% of the royalties collected from generation and distribution business, soft loans raised from multilateral donors sub-lent to NEA, 1% of the revenue collected from power plants and 5 to 10% of the electricity tariff.

5.10.2.4 Institution

The present level of WEC budget needs to be sufficiently raised so that the WEC can function smoothly. Donor collaboration should be sought for the flexibility in human resources development and easy access to outside technology.

5.10.2.5 Rural Electrification

Cost sharing with the community in extending distribution lines could be more effective. Similarly, promoting the involvement of the community in electricity distribution will help reduce the handling cost and leakage of electricity.

5.10.2.6 Other Water Sub-sectors

Annual costs for environmental protection, water-induced disaster prevention, river basin planning, data collection and institutional requirements should continue to be managed through HMGN's recurring budgets. In the case of commercial fisheries, water-related tourism and other industrial water uses, it is expected that the policy of full cost recovery will be applied.

5.11 International Context

Large exports are not planned as it would depend on market. However, there is significant scope for power export if private multinational investments can be attracted. There is large deficit of energy in both India and Bangladesh. India has projected the need of additional

65,000 MW of hydro electricity by 2010 and that country's shortage will be large (about a third) in Uttar Pradesh and Bihar. Large chunks of under-developed potential lie in the Brahmaputra Basin and it is much farther from load centres compared to Nepal. Similarly, Bangladesh also has projected a deficit of 5,000 MW by 2020. The typical cost of extracting electricity from hydro in India is about US$1,800/KW. The cost of extracting energy from coal in India is close to US$1,200-1,400/KW, which is not cheap, given the environmental costs. The present extraction cost of hydro electricity in Nepal is about 15 to 20% less (excluding storage projects) compared to India. The regional power grid concept should be promoted by Nepal to take additional advantage of power export.

Part D. Environmental Plan

6. Environment Management Plan

6.1 Introduction

An environmental management plan (EMP) is a strategic document which deals with a plan for the implementation of environmental protection measures, monitoring and auditing programmes and institutions and procedures. The actions prescribed by the plan may contain several environmental issues of both adverse and beneficial character. They may need to be addressed properly in the implementation of the actions prescribed by the plan. Therefore, the EMP at the strategic level deals with:

- summarization of strategic issues identified in the strategic environmental assessment (SEA);
- formulation of mitigation prescriptions to be applied at strategic level and implementation of plan;
- monitoring and auditing of programmes to be implemented; and
- institutional and procedural arrangements.

6.2 Implementation of Mitigation Plan

Most of the mitigation measures and alternative options proposed at strategic level constitute three actions. They are:

- rewriting strategies or action plans or the actions prescribed in the NWP;
- developing policy guidelines, standards and norms; and
- shifting responsibility at the project level for implementation.

6.3 Environmental Components

The implementation of strategic actions proposed by the NWP is likely to affect the following components of the environment. The issues identified at the strategic level constitute parameters of broad category, which upon implementation at the project level, become specific impact.

6.3.1 Physical Component

The following table depicts the strategic issues and the mitigation prescriptions to be implemented at strategic and project levels.

6.3.2 Biological Component

The implementation of strategic actions as proposed by the WRS, sub-sector action plans and NWP is likely to affect parameters of the biological components. The effects in the form of issues constitute the broader concerns and upon their implementation at the project level may constitute specific impact.

The following table summarizes the strategic issues and mitigation measures at the strategic- and project-level implementation.

Table 6.1: Implementation of Mitigation Measures at Strategic and Project Levels (Physical component)

	Mitigation Measures		Implementation	
Strategic Environmental Issues	**Strategic Level**	**Project Level**	**Strategic Level**	**Project Level**
1) Reduction of downstream water flow during dry season	Compulsory downstream water requirement as a water right, as well as the release of minimum 10% of lean season flow	Water required in the downstream and 10% of lean season flow should be released or compensation should be paid to downstream water users	Statement made in mitigation measures should be made a policy statement, followed by plan and programme on the compensation	Actual implementation in construction and operation takes place or Compensation to be paid
2) Inundation of upland fields and flooding	Compulsory measures should be provided on compensatory plantation/use of new water bodies/compensation of land and property.	Mitigation measures at project level should provide for compensatory plantation and a plan for use of new water bodies	NWP must make provision for compensatory plantation/ compensation	Carry on plantation/compensation
3) Downstream water pollution and groundwater quality	Actions to make water treatment actions compulsory and compliance with water quality standard should be outlined	Design treatment plant for waste water and irrigation return flows	Development of policy guidelines for treatment of waste water and irrigation return flow and produce manual of water quality standard	Implementation of water treatment plant before disposal takes place; comply with standard; reduction in use of chemical fertilizer and pesticide
4) Cloud burst, Glacier Lake Outburst Flood (GLOF) and Lake Outburst Flood (LOF)	1) Contingency plan 2) Early warning system 3) Information network	Establish monitoring stations at strategic points and establish information dissemination system	A manual for contingency and information dissemination plan	Establishment of monitoring stations, recording and reporting systems
5) Erosion/landslide and sedimentation	In the NWP, compulsory watershed management and bioengineering activities.	Watershed management and bioengineering as compulsory components of water development project; conduct scientific tests and define the necessary activities	Policy guidelines for watershed management and bioengineering should be developed	Implementation of watershed management or catchments area protection programmes
6) Air quality and microclimate	Air quality standard and measures to reduce Green House Gas (GHG)	Measures to reduce dust pollution and removal of plant debris from storage project	Air quality standard and a manual to reduce GHG	Implement measures to control dust pollution during construction
7) Extraction of groundwater	A system of imposing levy and permitting authority for groundwater extraction	An appropriate mechanism for imposing levy and groundwater extraction permission authority should be established	A system of imposing levy and rules and regulation to control groundwater extraction	Implementation of practical levy system and enforcement
8) Waterlogging and inundation	Provision of compulsory installation of drainage system.	Drainage design for all forms of irrigation project should be provided	Development of guidelines for installation of drainage system	Implementation and construction of drainage system to reduce water logging and inundation
9) Soil deterioration and sedimentation	Compulsory construction of de-sanding basin related to irrigation and hydropower development	As a part of project, de-sander should be designed to be constructed	A manual for designing desanding basin	Construction of desanding basin in irrigation and hydropower projects
10) Water pollution and sanitation	Compulsory treatment of sewage and compliance with water quality standard before being discharged into rivers	Design of the water treatment plant to be installed in water supply project	A manual for water quality standards; prepare a manual for waste water treatment plant.	Construction of treatment plants in water supply and sanitation projects
11) Effect on mountains	Provision of mountaineering database	None	None	None
12) Cultural endowment	Cultural endowment	Create funds	Implementation of fund	Implementation of fund
13) Taxes and royalties	Tax and royalties system endowment	Utilize funds	None	Implementation

Table 6.2: Implementation of Mitigation Measures at Strategic and Project Levels (Biological component)

Strategic Environmental Issues	Mitigation Measures		Implementation	
	Strategic Level	**Project Level**	**Strategic Level**	**Project Level**
1) Effect on forest and vegetation	Protection, conservation and enhancement of forest and vegetation should be dealt with	Compensatory plantation, protection and conservation action plan should be developed	Forest management, plantation and protection guidelines should be developed	Implementation of plantation and protection programme
2) Effect on wildlife/biodiversity	Biodiversity conservation prescription should be provided in NWP as a separate component	Biodiversity conservation and protection measures should be provided	Biodiversity protection action plan in relation to water resource development should be formulated	Implementation of biodiversity conservation action plan.
3) Effect on aquatic life and wetland ecosystem	Some strategic prescriptions are required to be integrated in the NWP	Implementable prescriptions are required to be developed	Guidelines to implement aquatic ecology protection and watershed management	Implement aquatic ecosystem protection and watershed management
4) Issues of protected areas	National parks and protected areas are protected by their own stringent laws and regulations. Water resource development project to be implemented in protected areas is the concern of Ministry of Forest, Ministry of Environment, Science & Technology, Ministry of Health & Population and Ministry of Water Resources	Guideline should be developed	None	Implementation as per guideline

6.3.3 Socio-economic Component

The implementation of the strategic actions as proposed by the NWP, WRS and sub-sector action plans is likely to produce effects on the socio-economic parameters of the environment. The issues identified at the strategic level constitute the broader areas of concern. Upon their implementation at the project level, the issues become specific impact.

The following table provides specific strategic issues and mitigation measures at strategic and project levels.

6.4 Environmental Monitoring

6.4.1 Monitoring

Monitoring is an activity undertaken to provide specific information on the characteristics and functions of environmental and social variables in space and in time. Monitoring is an 'action-oriented' activity, designed to determine the extent to which environmental mitigation strategies are working.

Table 6.3: Implementation of Mitigation Measures at Strategic and Project Levels (Socio-economic component)

Strategic Environmental Issues	Mitigation Measures		Implementation	
	Strategic Level	Project Level	Strategic Level	Project Level
1)Employment opportunity	Policy for: 1) employment for local people 2) reasonable wages 3) training and health insurance 4) HRD	Give priority to local people good wages and health insurance	Develop HRD and employment plan	Train and employ local people
2)Economic activities (including tourism and others)	Formulate plan for maximization of economic benefit	List economic activities and enhancement	Plan economic activities for local people	Implement economic activities
3) Local market development	Formulate plan for enhancing of local markets	Give prescriptions for enhancing local markets	Coordinate guidelines for local market development	Implement projects to enhance local market
4) Reduction in drudgery to women and children	Formulate a detailed plan for implementation	None	None	None
5) Boom and bust cycle	Formulate a plan for employing workers upon completion of NWP activities	Properly use skilled human resources and manage boom and bust cycle	Prepare a planning document to manage boom and bust cycle	Use trained human resources in the implementation of similar projects.
6)Land acquisition, displacement and resettlement	Finalize the compensation and resettlement guidelines	Develop project-specific compensation and resettlement action plan	Develop a practical guideline of compensation and resettlement (ACRP Guidelines)	Implemention of compensation and resettlement action plan
7)Effects on cultural/archaeol ogical practices	Draft a policy, plan and programmes to protect, conserve and preserve cultural assets of the local area	Provide actions for cultural preservation	Develop a guidelines, norms, and other means of preservation of culture	Implement measures to protect culture and traditional values
8) Pressure on social services	Make provision for the management of pressure on social services in local areas	Provide actions to mitigate the pressure on social services in local area	Develop policy guidelines to prevent pressure on social service	Implement actions to alleviate pressure on social service
9) Gender/child labour issues	Specify the percentage of female participation in NWP proposals	Provide actions to encourage female participation and to discourage child labour	Develop a manual for gender participation in development work	Enhance child career development
10) Rural electrification	Clearly spell out in the policy what percentage of electricity generated should be distributed locally	Develop a project-level plan for rural electrification	Develop policy guidelines for rural electrification	After electricity generation, carry out the task of rural electrification

Monitoring at strategic level involves:

- examination of the outcomes of the implementation of strategic actions;
- strategic actions translated into project-level actions, which upon implementation fulfill the strategic objectives, and
- the feedback from the project-level actions furnishes information on the effectiveness of the NWP implementation and if it is found not effective, the information would also provide a basis for the reformulation of the NWP and action plans.

Environmental monitoring is one of the most important components of SEA. It is essential for:

- ensuring that impact does not exceed the established legal standards,
- checking the implementation of mitigation measures in the manner described in the SEA report, and
- providing early warning of potential environmental damage.

6.4.2 Types of Monitoring

Various types of monitoring activities are currently in practice, each of which is relevant to NWP implementation. The main types are:

6.4.2.1 Baseline Monitoring

An extensive review of the existing literature on the WRS, sub-sector action plans and NWP has been carried out in relation to basic environmental parameters which are likely to be affected by the proposed NWP. Subsequent monitoring can assess the changes in these parameters over time against the baseline.

Baseline information is compiled and maintained in a database of environmental conditions before the implementation of the NWP. This is especially important if the implementation of the Plan is delayed due to unforeseen circumstances and if information given in the database needs to be updated. The baseline data recorded before the implementation will facilitate the comparison of the information obtained during the monitoring activities and in auditing. The main strategic parameters that need to be considered during baseline monitoring of NWP are follows:

(a) River Flow Rate

Gauging stations should be established at different strategic sites to collect accurate information on seasonal variations in the river flow rate and the contributions of major tributaries. The station will also give a more accurate account of flood levels.

(b) Glacial and Glacial Lakes

Any glacial lake in the river basin should be studied in detail and regularly monitored to identify the potential for GLOFs.

(c) Water Quality, Air Quality and Noise Levels

As far as possible, the primary data on water quality, air quality and noise levels should be collected with the help of portable equipment.

(d) Stability of Slopes

The fragile slopes in the project area should be monitored regularly to provide early warning on potential landslides. The condition of slopes should be monitored before and after the monsoon.

(e) Sedimentation Level

This should be studied in detail and regularly monitored.

(f) Community Forestry

Community forestry has been introduced in many parts of Nepal. Forest user groups (FUGs) are a new phenomenon; the existing FUGs are only a few years old and their management systems are not well-established. The effectiveness of FUGs in managing forests should be monitored with the help of the District Forest Office in the project area.

(g) Settlements

The settlements in the possible project area may be expanded significantly due to the opening of overland transportation services, resulting in increased traffic and trade, and due to the supply of electricity. Both of these events are expected to occur. The growth of settlements will increase the significance of environmental impact. Baseline monitoring should be carried out periodically to determine changes in human population and structure, trade and other socio-economic activities, including local institutions and the status of public facilities, religious sites and cultural artefacts.

Most of the parameters are generic in nature. Information generated at the strategic level would furnish a basis for comparison before and after the Plan implementation.

(h) Cracks

Cracks in the existing structures should be monitored.

6.4.2.2 Impact Monitoring

The strategic issues on physical, biological, socio-economic and cultural parameters to be affected by the NWP and sub-sector action plan implementation have been identified. In the process of Impact monitoring, the changes that are likely to take place during plan implementation will be detected.

The impact caused by project implementation should be closely monitored during the construction and operation of the project to examine the effectiveness of the mitigation measures, which essentially reflects the mitigation prescription given at the strategic level. The following activities need to be conducted for impact monitoring.

(a) Hold regular meetings with the local people and listen to their concerns to assess the impact of the project on the community and the environment.
(b) During construction, regularly assess the stability of disturbed slopes. This is particularly necessary during the monsoon season (complying with the activities of Output 1 of the WRS).
(c) During construction, inspect the levels of air, noise, cracks and water and land pollution at regular interval and compare with national standards and baseline data (complying with the activities of Output 2 of the WRS).
(d) During and after construction, conduct regular fish sampling to assess the impact of the project on the fish population and their spawning and migratory behaviour (complying with the activities of Output 2 and 6 of the WRS).
(e) With the help of FUGs, regularly monitor the condition of local forests and the use of in addition to trafficking in forest produce.
(f) Monitor the spoil disposal practice (complying with the activities of Output 1 of the WRS).
(g) Monitor storage technique for fuel and explosives kept in the project area to ensure safety to people and the environment (complying with the activities of Output 1 and 2 of the WRS).

(h) Check the water sources, water supply and sanitation situation in the project area, including labour camps and construction areas, and regularly test the quality of water being supplied to construction workers (complying with the activities of Output 3 of the WRS).
(i) Regularly check the health of workers to ensure that there is no spread of communicable diseases. Also, regularly check the construction safety, ensuring the maintained health of workers.
(j) With the help of the local police, monitor the occurrence of criminal and socially undesirable activities.
(k) Monitor the gender issues related to the project to ensure that neither males nor females bear an unfair share of negative impact.
(l) For at least three years following land acquisition, regularly survey the social and economic conditions of displaced families whose land and property have been acquired by the project.

6.4.2.3 Compliance Monitoring

This form of monitoring employs a periodic sampling method or continuous recording of specific environmental quality indicators or pollution levels to ensure project compliance with recommended environmental protection standards. The following activities should be conducted to ensure compliance with the NWP:

(a) Following the completion of the detailed design and tender documents, confirm that all mitigation, compensation and rehabilitation measures are in place.
(b) During contract negotiations, confirm that the designs and working methods proposed by the contractors have taken into account the environmental considerations stipulated in the tender documents.
(c) At the beginning of the construction, confirm that the arrangements regarding temporary use of land for labour camps, material storage and construction activities are satisfactory.
(d) At the time of land acquisition, ensure that the acquisition process is in accordance with the Land Acquisition Act 2034 and/or any project specific guidelines. Also, check that project-affected persons have received adequate compensation within the stipulated time.
(e) During construction, confirm on a regular basis that all the agreed working conditions and procedures regarding various environmental considerations are followed satisfactorily.
(f) During construction and upon completion of construction, ensure that all requirements regarding clean-up and reinstatement have been satisfactorily met.
(g) During the operation of the project, ensure that a minimum river flow along with the downstream water right is maintained, particularly during dry months.
(h) During operation, ensure that encroachment on any forest, wildlife habitat and/or ecologically-sensitive area that might exist does not take place.

Most of the above-mentioned actions can be monitored at the project implementation level. However, the compliance with the conditions given ensures the conditions given at the strategic level. For example, maintaining minimum river flow and fulfilling downstream water

rights are issues at the strategic level. However, their implementation has to be examined at the project-level actions.

6.5 Environmental Auditing

Auditing refers to the examination and assessment of a certain type of performance. In the case of strategic action, an audit should assess the actual environmental impact, the accuracy of prediction, the effectiveness of environmental impact mitigation and enhancement measures, and the functioning of monitoring mechanisms. As per Environment Protection Regulation (EPR) 54, an audit should be undertaken after the project has been operational for two years. It is usually performed once for each project.

6.5.1 Implementation of Audit

An environmental audit should be carried out after two years of project operation. Information from monitoring output should also be utilized for carrying out an environmental audit. In general terms, an environmental audit should gather information on the following areas:

- The conditions of natural, social and economic resources before and after project implementation;
- Whether the impact forecasted by the SEA has occurred and, if so, the extent of the impact;
- Whether or not the mitigation measures implemented have been effective to control adverse impact or enhance beneficial impact;
- Whether or not all landscapes degraded due to project implementation have been restored to their original (or better) conditions; and
- What is the impact of boom-bust scenario among the workforce involved in the project implementation and the local economy; and

The overall effect on the economy of project implementation.Specifically, the following activities and others, as deemed necessary, need to be addressed for environmental auditing.

- How have environmental conditions changed from the baseline conditions?
- Are there any problems related to slope stability in the project area?
- Have slope stability and erosion control measures adopted by the project been effective in minimizing slope instability, erosion and landslides?
- What is the quality of water in the river and its tributaries? Has it changed significantly from the baseline condition?
- Are there any bare and degraded areas around the project? What is the condition of quarry sites, burrow areas and spoil disposal areas?
- How are the local forest user groups functioning?
- What is the condition of the local forests?
- How are families resettled by the project adapting to their new host communities?
- How have the local construction workers adopted to the loss of their jobs following the end of the construction activities?
- What is attitude of the local people towards the project?
- What is the impact of the project on the local and national economies?

Although most of above parameters are answered at the project-level implementation, the information obtained during audit can also answer the strategic-level questions.

6.6 Institutional and Procedural Arrangements

WEC is the national planning body for water resources in Nepal. This body is constrained in the proper planning and monitoring of the implementation of the NWP. WEC has neither regional offices nor district offices to keep track of the implementation and monitoring of the NWP. Hence, it is recommended that the basin level offices, Kosi, Narayani and Karnali, which will appropriately, covered the area of other medium and small rivers should be established. Through these basin level offices, WEC is expected to be in better grip of the implementation and monitoring of the NWP. These offices will work as a link and media for information and data collection from district and project-level water users under different line ministries and independent agencies and private sectors. These primary data and first-hand information will provide the basis for WEC to update, revise and improve the policy plan and programmes related to water resources. These offices will also have the responsibility of monitoring the implementation of the NWP and the WRS. These bodies will work as eyes and ears of the central body. These bodies can also work as the guardian of the national water resources. They can provide necessary technical input and training services for various users of water resources on various issues such as water quality, water law, plans, policies and programmes, assistance to water user groups, coordination between different water user agencies and technical support for water dispute settlement process. On the whole, the job description of the basin level offices could be as follows.

(a) To advise HMG/MoWR/WEC to allocate water resources to different sub-sectors on the basis of predetermined plan, policy and guidelines and laws of HMG;
(b) To collect data and information necessary for water resources planning;
(c) To assist WEC in the preparation of regional plans for water resources;
(d) To monitor and control water users and water-related institutions for compliance with water-related environmental and other conditionalities;
(e) To assist in the settlement of water-related disputes among different users.
(f) To protect water sources and take necessary preventive measures;
(g) To enforce and monitor the compliance with the implementation of the NWP, and
(h) To provide technical backstopping for local governments and other line agencies in the implementation of the NWP.

However, for the present, the activities mentioned above would be carried out by river basin cell(s) to be established at WEC. Eventually, the regional or basin offices will be established as the NWP implementations gains momentum in true spirit and intent.

Part E. Monitoring, Evaluating and Updating the Plan

7. Basic Frameworks

The NWP is a long-term plan and covers a period of twenty-five years. As any other long-term plan, this plan also needs to be monitored, evaluated and updated at a regular interval. Monitoring and evaluation involves comparison of activities and impact against predetermined objectives and targets, using requisite criteria. As WEC has been designated as a central water planning authority, it will have to take the primary responsibility of monitoring, evaluating and updating the WSS and the NWP at an interval preferably coinciding the NPC's mid-term review period.

The existing project monitoring system will be made more effective and objectivity maintained. Programme-level monitoring will be conducted by sectoral ministries, whereas the overall monitoring of the NWP will be WEC's responsibility. Each of the programmes has immediate objectives and indicators. These objectives and indicators have been included in the Plan. The programme-level progress can be monitored by tracking each indicator, while, at the project level, indicators will be identified, which can be objectively verified, whereas annual programmes and budgets are approved by the government. Project-level indicators will be formulated keeping in view the overall programme indicators in sight. The basic framework for monitoring and evaluation is depicted in the following diagrams:

7.1 Basic Framework for Monitoring:

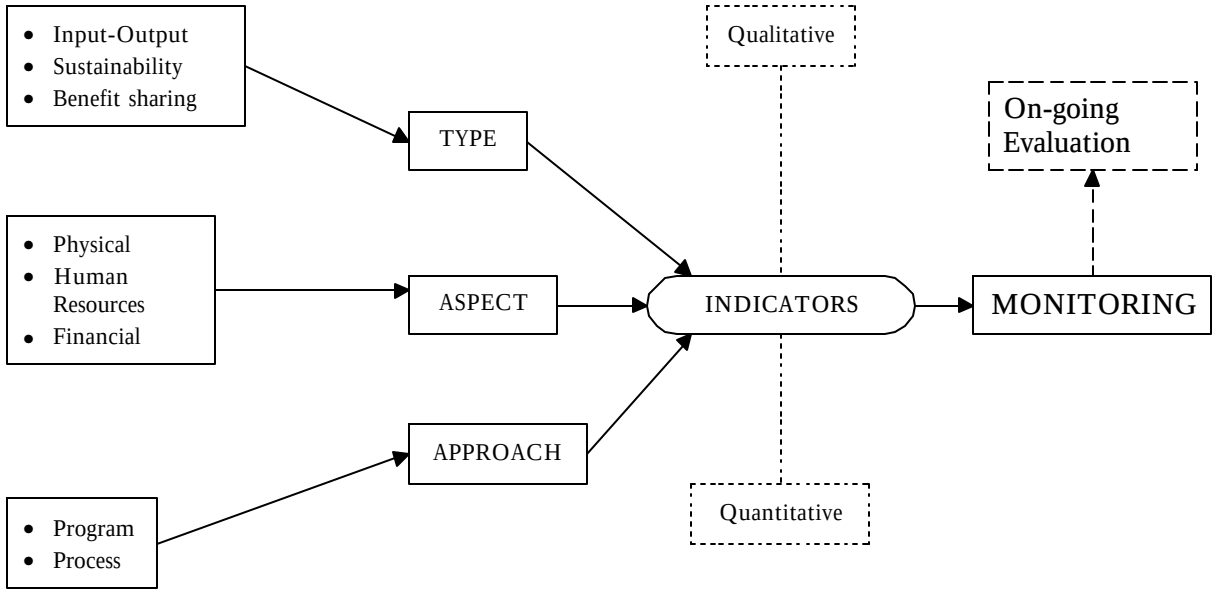

Fig. 7.1 Basic Framework for Monitoring

7.2 Basic Framework for Evaluation:

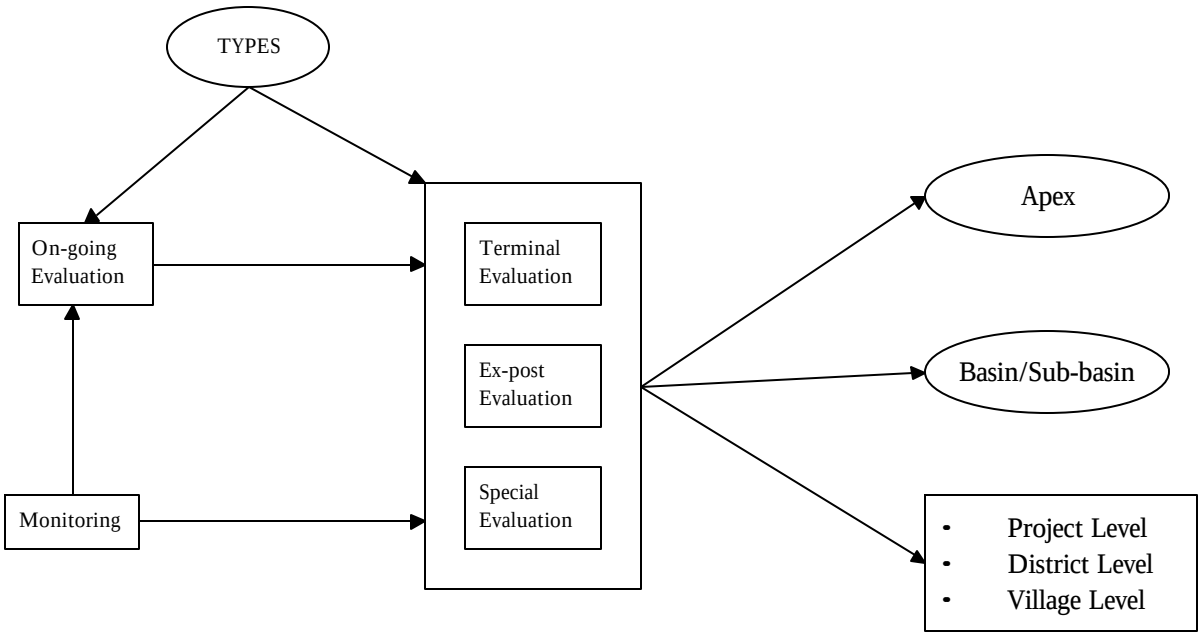

Fig. 7.2 Basic Framework for Evaluation