

Bhutan Water Policy



Royal Government of Bhutan



Bhutan Water Policy

Royal Government of Bhutan

Published by
National Environment Commission,
Thimphu Bhutan, 2007

Front Cover:

*The Wang Chhu River at Dodena in the upper reaches of Thimphu Valley.
Picture by Thinley Namgyel*

Design & Layout by Thinley Namgyel

Contents

1. INTRODUCTION	2
2. WATER VISION FOR BHUTAN	6
3. NEED FOR WATER POLICY	7
4. POLICY STATEMENTS	8
5. WATER USER INTERESTS AND PRIORITIES	9
5.1. Allocation of Water	9
5.2 Water for Drinking and Sanitation	9
5.3 Water for Food Production	9
5.4 Water for Hydropower Development	10
5.5 Water for Industrial Use	10
5.6 Water Use and Conflicting Users' Interests	11
6. PRINCIPLES OF WATER RESOURCES DEVELOPMENT AND MANAGEMENT	12
6.1. Water Resources Development	12
6.2. Water Resources Management	12
6.3 Value of Water	14
6.4 Water Resources Protection	14
6.5 Flood Control and Management	15
7. INSTITUTIONAL DEVELOPMENT FOR WATER RESOURCES MANAGEMENT:	16
7.1. Institutional Set Up	16
7.2 Responsibility for the Management of the Water Resources	17
7.3 Management of Information System	17
7.4. Human Resources Development	17
7.5. Applied Research in Water Resources Development & Management	18
8. INTERNATIONAL WATERS	19
8.1. Trans-boundary Water Resources	19

1. Introduction

- 1.1 Bhutan has been consistently following a conservation-centered development policy. This policy has been inherited from the wisdom of our forefathers who knew that ensuring the integrity of forests, rivers and soil are vital to their survival in the mountainous environment. Their wisdom, which has been synthesized into our modern development philosophy, has been crucial in maintaining a good natural resource base. As the main outcome of this conservation policy, 72.5% of the country is under forest. This good vegetative cover on a mountainous topography with a fair spatial distribution of precipitation of 4000-5000 mm in the foothills, 700-2500 mm in the inner valleys and mid hills and 700-1000 mm in the high altitude regions has endowed the country with rich water resources. Fed by snow and rain, the country is drained by four major rivers and their numerous tributaries. Their average flow draining the country's area of 38,394 km² is estimated at 2,325 m³/s (Water Resources Management Plan, 2003), which is 73,000 million m³/annum with per capita availability of more than 100,000 m³. The mountainous topography, with altitudes varying from 100 meters to over 7,500 meters above sea level, drained by these rivers and their tributaries has given the country a high potential for hydropower development.
- 1.2 However, Bhutan cannot afford to be complacent. The country is confronted with localized and seasonal water shortages for drinking and agricultural purposes. Only 78% of the country's population has access to safe drinking water and about 12.5% of the arable land is irrigated. The high per capita availability of water at the national level is in stark contrast to local water scarcity, which has become a serious impediment to development. This problem of access to water is caused by the settlements being on the slopes while the major rivers flow at the valley bottoms. However, the country's annual precipitation gives some prospect to deal with the local water scarcity. Harvesting a small fraction of this huge quantity of rainwater has the potential to solve the local water scarcity problems and lead to judicious use of available water
- 1.3 There is increase in fluctuation between lean season and monsoon season flows leading to sub-optimal utilization of generating capacity of hydropower plants. The increasing sediment load in rivers is decreasing the expected output and economic life of hydropower plants. The uneven distribution of precipitation over the fragile mountainous environment makes the country highly vulnerable to landslides, floods, droughts and impacts of climate change.
- 1.4 Pressure on water resources is mounting due to competing demands from different users. In the past, water was mainly used for domestic and agricultural purposes. Even the demand for domestic water is increasing due to changing lifestyles caused by rapid socio-economic development. Similarly, the water demand by agriculture is expected to increase due to production intensification

to keep pace with food demands of a growing population. New demands from other sub-sectors such as hydropower and industries are emerging and must be accommodated. Rapid urbanisation is taking place, which has serious impacts both on water demand in terms of quantity required and the associated pollution that impairs quality.

- 1.5 Effective watershed management is imperative for water resources conservation and sustainable utilization. However, due to the rapid pace of socio-economic development, there is increased pressure on the watersheds. Although harvesting of forest produce is based on sustainable management plans, increasing demand for timber, firewood and non-timber forest produce is starting to have negative impacts on watersheds. Further, forestland encroachment and forest fires have become challenges for watershed conservation. Therefore, watershed management as the reservoir of water and other related resources is a challenge that must be addressed collectively in the interest of all resource users.
- 1.6 At a growth rate of 1.3% per annum, our population will double in the next fifty years. About half the population are projected to live in urban centres. Such a concentration of population poses a serious challenge to delivery of services and waste management of a burgeoning population. Given the limited arable and plain land, such concentration will undermine sustainable management of land and water resources, compromising the low carrying capacity of the fragile mountainous ecosystem.
- 1.7 Climate change has serious impacts on Bhutan. Glacial Lake Outburst Floods (GLOF) are increasingly becoming threats due to melting of glaciers triggered by climate change. GLOFs have serious impacts on life, properties and future infrastructure development in the country. Another major impact of climate change will be in reducing the natural flow regulating capacity of the glaciers for our rivers with serious consequences on our water resources. Therefore, since Bhutan is affected by phenomenon on which we have no control, we must participate in international forums on climate change to negotiate on mitigation measures for our important resources.
- 1.8 The existing water user institutions have weak functional linkages at policy, planning and programming levels. The different sub-sectors have been performing their respective responsibilities independent of each other. This has resulted in fragmented data, duplication of efforts and poor resource management system. It has sacrificed the synergy of integration. For instance, the drinking water program is looked after by two ministries: urban water supply is under Ministry of Works and Human Settlements and rural water supply is with the Ministry of Health. Similarly, while the Ministry of Agriculture handles irrigation and land-use, hydropower development and

hydro-meteorological data collection and GLOF are looked after by the Ministry of Trade & Industry. Such an institutional set up has, above all, resulted to the absence of a national policy on water which is an important national resource and created sub-sector based institutions leaving rooms for potential conflicts among them.

- 1.9 The Royal Government established, in August 2001, a multi-stakeholder body called Bhutan water Partnership, comprising of relevant agencies in the water resources sector, as an interim measure, to undertake the following activities:
- (i) To co-ordinate and formulate a broad national water policy along with the required legislation;
 - (ii) To co-ordinate and prepare the Bhutan Water Vision for the next twenty five years;
 - (iii) To co-ordinate and prepare water action plans for integrated water resources management on plan period time horizon;
 - (iv) To co-ordinate and prepare the institutional linkage mechanism within and beyond the water resources sector;
 - (v) To review and co-ordinate the preparation of a comprehensive HRD plan in the water resources sector;
 - (vi) To act as the national counterpart to consultants involved in policy formulation and management of water resources;
 - (vii) To act as a policy advisory committee to the government on water resources protection, development and management;
 - (viii) To act as the focal body to the South Asian Network of the Global Water Partnership; and
 - (ix) To monitor and evaluate the programs on water resources implemented by the different sub-sectors
- 1.10 There is no law on water in its own merit. However, some provisions related to water issues exist in some existing Acts such as the Land Act, 1979, Forest and Nature Conservation Act, 1995, Environment Assessment Act, 2000, Bhutan Electricity Act, 2001 and Water and Sanitation Rules (framed in pursuance of the Municipal Act 1999). These provisions are not comprehensive and are sometimes contradictory, inconsistent and conflicting with each other. Besides, the people also practice customary law and norms, which differ from village to village. Therefore there is a need for the enactment of a comprehensive law on water.
- 1.11. On the international front, Bhutan is signatory to the United Nations Convention on the Law of the Sea, UN Framework Convention on Climate Change, Kyoto Protocol to the UN Framework Convention on Climate Change; Convention on Biological Diversity;; Cartagena Protocol on Biosafety to the Convention on Biological Diversity; Convention on International Trade in Endangered Species of Wild Fauna and Flora (CITES); Basel Convention

on the control of Transboundary Movements of Hazardous Wastes and their Disposal; UNESCO World Heritage Convention; International Plant Protection Convention (Adherence); Statute of the Centre for Science and Technology of the Movement of Non-Aligned Countries and other Developing Countries; Statutes of the International Centre for Genetic Engineering and Biotechnology.

2. *Water Vision for Bhutan*

Vision Statement

Water is the most important natural, economic and life-sustaining resource and we must ensure that it is available in abundance to meet the increasing demands. Present and future generations will have assured access to adequate, safe and affordable water to maintain and enhance the quality of their lives and the integrity of natural ecosystems.

- 2.1 Nature, water and human life are interdependent and inseparable and must coexist in harmony and balance.
- 2.2 To achieve this vision, water must be used and managed sustainably, efficiently and equitably while recognizing and preserving the environmental, social, cultural and economic value and uses of water.
- 2.3 All water users, planners and decision-makers shall be adequately informed, educated and encouraged to value and protect water in all its forms and uses.
- 2.4 Realizing this vision requires the involvement of all people in Bhutan working in a continuous partnership within an enabling policy, legal and institutional framework.

3. Need for Water Policy

- 3.1 Water is a precious natural resource, a basic human need for survival. The development and management of water resources must be therefore guided by national conservation and sustainable development policies.
- 3.2 The Royal Government has taken the decision that sustainable agriculture development, harnessing hydropower potential and industrial development shall be the main avenues of socio-economic development. Water is one of the main resources required in fulfilling this important national objective of socio-economic development. Therefore, the need for a water policy to guide the sector in the best interest of the nation cannot be over-emphasized.
- 3.3 Water is finite. Socio-economic development inevitably leads to increasing demand of water for diverse purposes: domestic, agricultural, hydropower, industrial, recreational etc. Water is a crucial element in all these development areas. Therefore, conservation, development, utilization and management of this important resource have to be guided by national goals.
- 3.4 The need for an integrated approach is crucial for effective management of water resources for fulfilling our diverse national objectives. An enabling environment shall be created for active participation of all stakeholders and for an integrated water resources management.
- 3.5 Floods including GLOF affect vast areas resulting in loss of lives and properties. It is essential to develop a national adaptation strategy for climate change, including a national flood management and mitigation strategy.
- 3.6 A common framework for water resources assessment is crucial for informed decision-making. The inventory of water resources both in terms of quality and quantity needs to be developed.
- 3.7 There is a need for coordinated efforts on all water resources development in the country. It is also pertinent that an institution be created to ensure an integrated approach in the management of water resources and its sustainable utilization.

4. Policy Statements

- 4.1 The Bhutan Water Policy is a reflection of the Royal government's commitment on the conservation, development and management of the country's water resources. It recognizes that water is a precious natural resource and a heritage important to all aspects of social, economic and environmental wellbeing. Therefore, water resources must be carefully conserved and managed in order to promote national development without compromising the integrity of the natural ecosystem.
- 4.2 The policy adopts an integrated approach, which recognizes natural linkages. Emphasis is placed on water resources management within river basins and aquifers, including both upstream and downstream water users. Surface and ground water must be seen as two forms of the same resource, often with close linkages. Water quality and quantity are important and interlinked. Water resources must be planned and managed in a coordinated manner.
- 4.3 Water is crucial for development since it is the resource that guarantees basic wellbeing for all. Water programs must address balanced development and grant equitable access to this basic resource to meet the basic condition for happiness thereby contributing to the national goal of Gross National Happiness (GNH)
- 4.3 Water support human sustenance and therefore has direct linkage to poverty. Recognizing this strong linkage, water related programs shall address poverty and offer people their right to respectable livelihoods.
- 4.4 The policy shall cover all forms of water resources including snow, glacier, rivers, lakes, streams, springs, wetlands, rainwater, soil moisture and groundwater.
- 4.5 The Water Policy views water resources from a broad, multi-sectoral perspective while recognising the responsibility of the sub-sectors to play their part in meeting the policy objectives. The policy principles are thematically grouped as follows:
 - i) Water user interests and priorities;
 - ii) Principles for water resource development and management;
 - iii) Institutional development for water resources management; and
 - iv) International waters.

5. Water User Interests and Priorities

5.1. Allocation of Water

- 5.1.1 When water resources are not sufficient either in quantity or quality to meet every legitimate demand, water for drinking and sanitation for human survival shall be the primary priority. Water for irrigation, hydropower generation, industrial use, recreation, and other uses shall be considered based on national and local priorities. Water legislation and management practices should allow for flexibility for adopting practical local solutions.
- 5.1.2 Water is indispensable for nature conservation and this shall be a guiding element in water allocation decisions.

5.2 Water for Drinking and Sanitation

- 5.2.1 Water is essential for human survival and health. Therefore every individual has the right to safe, affordable and sufficient quantity of water for personal consumption and sanitation.
- 5.2.2 The goal of the Royal Government shall be to provide universal access to safe drinking water and sanitation. While doing so, national standards for water quality shall be developed and followed.
- 5.3.3 There are reports of drying up of streams and springs as sources for drinking water. Consistent efforts shall be made to protect and conserve drinking water sources and the best available water sources shall be allocated for drinking purposes. In addition, alternative sources like groundwater and rainwater harvesting shall be explored in areas with water shortage.

5.3 Water for Food Production

- 5.3.1 Sustainable agriculture development is an important component of socio-economic development. It is the source of livelihood for 69% of the population. Adequate water allocation to this sector is indispensable for achieving overall national food security. Therefore, water allocation to the sector must be compatible with this national objective. A certain provision of water for consumption by domestic animals has to be made.
- 5.3.2 Agriculture consumes the highest percentage of water. With population growth and increasing competition for water from other sub-sectors, it is imperative that higher efficiency (“more crop per drop”) has to be achieved through adaptive and applied research. In order to address seasonal and local water shortages, other sources of water like groundwater and rainwater harvesting shall be promoted wherever feasible.

- 5.3.3 As agriculture production has the potential to pollute water resources through use of fertilizers and pesticides, efforts will be made to manage soil and pests without using excessive chemicals to avoid pollution of water resources from non-point agriculture sources.
- 5.3.4 The role of the rivers as an aquatic habitat and as a source of food shall be recognised.

5.4 Water for Hydropower Development

- 5.4.1 The mountainous topography of the country, with varying altitudes and swift flowing rivers in deep valleys carrying sufficient run-offs originating in fairly un-disturbed watersheds, provides the advantage for hydropower development.
- 5.4.2 Hydropower shall continue to be the backbone of the Bhutanese economy providing adequate energy for growth.
- 5.4.3 Hydropower development as a non-consumptive use of water, its significance as a renewable, non-polluting and clean form of energy and its potential for earning revenues from export shall be recognized. The sub-sector's tremendous potential for socio-economic development of the Kingdom shall be harnessed in a sustainable manner.
- 5.4.4 Hydropower development and transmission of energy have linkages with upstream, downstream and en-route water and land-users and therefore there is a need for cooperation and coordination in working out tradeoffs. These shall be approached through consultation and all users shall consider tradeoff, keeping in view the overall national interest.

5.5 Water for Industrial Use

- 5.5.1 The need for water by industries shall be recognised. Its rational and efficient use with proper disposal of wastewater is mandatory. The prospect of mountain spring water as an environmentally clean product shall be encouraged.
- 5.5.2 Development of tourism and recreational potential on Bhutan's watercourses will create additional opportunities and shall be promoted in a sustainable and environment-friendly manner. The potential of hot springs, which have medicinal, cultural as well as recreational value, shall be promoted.

5.6 Water Use and Conflicting Users' Interests

- 5.6.1 Competing water uses which result in conflicting water users' interests shall be solved through legal instruments. Legislation related to water that exist in various Acts are not comprehensive, and does not address the current and future water issues sufficiently. There is therefore a pressing need to enact a comprehensive legislation on water, which shall regulate water use in a sustainable way, resolve water-related conflicts, and ensure necessary conservation of water resources. The Water Act shall recognize and respect customary rights that are based on justice, equity and good faith.
- 5.6.2 Water in Bhutan shall be a common good. The State shall have the right to regulate the use of water resources and intervene in cases of conflicts. However, water management shall be broad-based with the involvement of all stakeholders through a consultative process. The use of water shall be open to all legitimate users under the provisions of the Water Act.
- 5.6.3 A comprehensive water legislation and regulations along with elaborate water abstraction procedures shall be developed. Licensing of activities that abstract water for commercial use shall be made mandatory. The licence shall specify the quantity, time frame, and quality of abstractions and discharge of effluents. The legislation shall also lay down provisions for a systematic registration of all forms of water uses, for the purposes of national integrated management plan and other uses.
- 5.6.4 The Water Act shall take into account international legal norms and conventions that Bhutan is signatory to.

6. Principles of Water Resources Development and Management

6.1. Water Resources Development

- 6.1.1 Sustainability of water resources means to integrate conservation, development and management on scientific basis, to maintain the safe yield of surface water sources, to prevent water pollution, to reduce the risks of flood and landslide damage and to promote the active participation of all stakeholders. Sustainable technical systems shall involve investigations, sound and affordable designs followed by construction of high quality infrastructure and their effective maintenance.
- 6.1.2 The use of appropriate technologies backed up by good management practices shall be promoted for saving water in households, agriculture and industrial uses.
- 6.1.3 Water resources development shall be carried out in an environmentally sustainable, economically feasible and socially acceptable manner.
- 6.1.4 Water resources development shall be based on applied research results and development activities relevant for Bhutan. These shall include programs and activities on source protection, groundwater abstraction, rainwater harvesting, recycling and reuse and innovative management practices. Integrated and coordinated development of surface and groundwater and their conjunctive use shall be promoted in feasible areas.
- 6.1.5 Water resources conservation, development and management programs are capital-intensive. A prudent fiscal policy to develop the sector shall be important for its growth. Investment from the private sector shall be encouraged. Preference shall be given to cost-effective, multi-purpose and multi-users projects.

6.2. Water Resources Management

- 6.2.1 Water resources management shall respect the integrity of rivers, surface and groundwater. As land-use has direct impact on water cycle, it is crucial that land-use planning take place at the river basin level. The upstream-downstream relationship has impact on the management of water resources. Therefore, water resource management in Bhutan shall be based on natural river basins. Conflicting user interests shall be resolved in a river basin context as a norm.
- 6.2.2 The main river basins shall form natural units of a national water management system. Appropriate institutional structures for water resources management at the basin level shall be developed.

- 6.2.3 Consistent water demand management shall complement the optimal development of water supply. Demand management shall include water-saving technologies, regulatory measures and enhancing public awareness. Pricing policies are effective tools for managing water demand, and this shall be an integral part of the water policy.
- 6.2.4 Water resources management shall be carried out in an integrated manner. Many water management problems, leading to crises of quantity and quality are associated with lack of integration, top-down management and disregard of upstream-downstream relationship. The important elements of an integrated water management shall include:
- ◆ Water flow circulation within the river basin, between the basins and the surroundings shall always be taken into consideration;
 - ◆ Land-use planning shall take place within the framework of the river basin;
 - ◆ It shall recognize the transport of matter, including polluting substances, that occurs between soil, air and water;
 - ◆ It shall recognize that usable water is always a function of both quality and quantity, and the two are strongly inter-connected;
 - ◆ Water supply and wastewater management shall be integrated at all administrative levels;
 - ◆ Rivers, lakes and other wetlands shall be sustained as biotopes for aquatic life;
 - ◆ All legitimate water users shall be equally respected, and have a voice in decision-making;
 - ◆ Central and local water management shall be consistent and interlinked;
 - ◆ Integrated water management shall include monitoring, data collection, analysis and access; and
 - ◆ Integrated water resources management shall also include management measures related to monitoring, early warning and mitigation of floods, landslides, damage to agricultural land and Glacial Lake Outburst Floods.
- 6.2.5 Participation of both genders in water resources management decisions shall be encouraged. Therefore, water related programs shall take into consideration the important role of women and men with respect to equal sharing of burden and benefits. Both men and women shall be involved in planning, development and management of water resources programs. A concerted effort to sensitize the importance of gender equity in water resources programs shall be implemented.

6.3 Value of Water

- 6.3.1 Water has an economic and a social value. Demand management techniques shall be introduced in order to achieve equitable sharing when there are competing water users. Economic instruments are efficient in modifying demand, and this shall be applied with care. Sustainable management of water as a resource is only possible when its full cost is acknowledged during planning and development of water projects. Cost recovery schemes shall include economic and environmental costs. Tariff structures shall therefore aim at sustainability of providing water.
- 6.3.2 Economic tools for water demand management will be introduced. Royalties or other means of rent/levy on water shall be considered for commercial water uses. Economic tools for promoting preferred or environmentally beneficial practices shall be promoted.
- 6.3.3 Use of water resources that causes pollution shall be regulated. The cost of pollution mitigation shall be based on the “polluter pays principle.”
- 6.3.4 The principle of cost sharing on water resource development and management shall be further strengthened to inculcate a sense of participation and ownership for sustainability.

6.4 Water Resources Protection

- 6.4.1 All forms of water resources shall be protected. Pollution impairs water quality, and hence reduces the water resource base. Pollution of water resources from urban development, agriculture, construction industry shall be controlled and the policy shall promote use of clean and appropriate technology.. Watersheds’ essential role as a sustainable source of water shall be protected.
- 6.4.2 Watersheds play an important role in regulating and maintaining water flow. The Royal Government of Bhutan shall ensure that adequate funds and resources are ploughed back for watershed protection and management. The plough back mechanism shall be used as an important tool for water resources management and development.
- 6.4.3 It is particularly important to protect the watershed providing drinking water. Surface water sources that are used for water supply shall be protected. The quality of groundwater shall be monitored in view of the potential future role of groundwater as a source of water, and co-ordinated with the general surface water quality monitoring.

- 6.4.4 Water quality will be maintained by creating awareness on water pollution. Environmental impact assessments shall give special considerations to impacts on water and aquatic life. Introduction of clean technologies for industrial production shall be promoted.

6.5 Flood Control and Management

- 6.5.1 Integrated and coordinated approach in flood control and management is essential. Action plans and programmes shall be developed for monitoring, early warning of flood hazards and disaster management. Particular attention shall be given to threats from floods, including glacial lake outburst floods.
- 6.5.2 Disaster management plan including forecasting, prevention, evacuation and mitigating measures shall be developed for flood-prone basins. Sound watershed management through extensive soil conservation, watershed area treatment, conservation of forests shall be promoted to reduce the incidence and intensity of floods. Flood forecasting and warning system shall be established along with regulations for human settlements and construction of physical flood protection works to minimize loss of life and properties due to floods.
- 6.5.3 Infrastructure for flood protection and damage prevention shall be strengthened. Flood zoning shall be carried out as an important disaster prevention measure. Measures to reduce threats from glacial lake outburst floods shall be taken up.
- 6.5.4 Unmanaged water has great potential for destruction and pose huge risks to assets, lives, economy and the environment. It is important to know the destructive capacity of water and take appropriate safety and management measures while dealing with water and related activities. This is the responsibility of every individual and organization that use and deal with water at individual or collective levels.

7. Institutional Development for Water Resources Management:

7.1. Institutional Set Up

7.1.1 The National Environment Commission shall ensure effective co-ordination of water resources management at the national level. The mandate shall include:

- ◆ Planning of water resources at national level,
- ◆ Formulation of water policy and required legislation,
- ◆ Monitoring and evaluation,
- ◆ Setting water quality standards and guidelines,
- ◆ International water co-operation.
- ◆ Licensing and regulating activities,
- ◆ Report to the Government/National assembly

Further, in collaboration with relevant sectors, the NEC shall coordinate:

- ◆ Research, development planning and support
- ◆ Capacity building and technical backstopping,
- ◆ Coordination of emergency preparedness,
- ◆ Data collection and distribution,
- ◆ Flood and disaster management related to water resources

7.1.2 The line ministries, departments, divisions and other organisations shall implement their respective functional responsibilities within the policy and legal framework. For ensuring effectiveness of the institutions in the water sector, better coordination and linkage mechanisms among them shall be promoted.

7.1.3 The Royal Government may form advisory bodies, from time to time, consisting of representatives from civil society and water users organizations, to provide advice to the government on water-related issues.

7.1.4 Operational management of water resources shall be carried out at the regional and local level with active participation of stakeholders. The practical management of water resources shall be implemented at appropriate levels. The line agencies shall ensure their linkage with local organisations to ensure effective implementation of activities on water with active participation of the beneficiaries. In line with the decentralisation policy, the Dzongkhag Yargay Tshogdu and Geog Yargay Tshogchung at the Dzongkhag and geog levels respectively shall play important roles in planning, implementation, operation and management of all water programs. The role of private sector and non-governmental organisations shall be encouraged in supplementing the services on water provided by the public sector. Private sector participation shall be guided by public authorities, which shall set the requirements for minimum service standards.

7.2 Responsibility for the Management of the Water Resources

- 7.2.1 The State shall act as the trustee of water resources and shall be responsible for overall regulation and management. Since water is a valuable resource that should be protected in the public interest, the State has an obligation to ensure a just, equitable and sustainable allocation among all legitimate water users including rationing during scarcity.

7.3 Management of Information System

- 7.3.1 A prime requisite for efficient water resource conservation, development, management and planning is a well-developed information management system. A standardized national information management system with network of data banks and databases shall be established. The establishment's main function will be designing information collection network and data collection with integration and strengthening of the existing central and dzongkhag level agencies. It shall work towards improving the quality of data and its processing. Information and Communication Technology (ICT) shall be adopted as an effective tool for this purpose. It shall facilitate free exchange of data among the various partner organizations for dissemination of information.

7.4. Human Resources Development

- 7.4.1 For efficient management and development of water resources, sufficient human resources, their skills and knowledge are important prerequisites. Therefore a prospective plan for training of planners, managers, implementers and the users shall form an integral part of the institutional capacity building measures. In this regard, priority trainings shall be imparted on information systems, cross-sectoral and integrated planning, multi-purpose project planning and formulation, project management, conservation, watershed hydrology, operations and maintenance of physical infrastructures related to water resources management and development.
- 7.4.2 Awareness campaigns and sensitizing all users on the importance of water are important aspects that need special attention. In this regard, there is need for training of sociologists and institutional experts to encourage efficient management and development of water resources.
- 7.4.3 Efforts should also be made to highlight the importance of water resources in the curriculum of all relevant educational institutions.

7.5. Applied Research in Water Resources Development & Management

- 7.5.1. For effective and economic management of resources and also to keep with the dynamics of change and development, constant efforts shall be made in applied research on water conservation, management and development.
- 7.5.2. The following areas need special attention:
- i) Hydrometeorology
 - ii) Assessment of the National Water Resources
 - iii) Surface water source and watershed protection
 - iv) Ground water hydrology and recharge
 - v) Water harvesting
 - vi) Water balance studies
 - vii) Crop water requirements and cropping systems
 - viii) Soil erosion and bio-engineering
 - ix) Flood control and mitigation
 - x) Erosion of the watercourse and sedimentation of reservoirs
 - xi) Safety of hydraulic structures
 - xii) Recycling and re-use
 - xiii) Best practices
 - xiv) Economic and financial planning
 - xv) Wastewater
 - xvi) Water pollution and prevention

8. International Waters

8.1. Trans-boundary Water Resources

- 1.1.1 Trans-boundary water issues shall be dealt in accordance with International laws and Conventions to which Bhutan is a signatory.
- 1.1.2 Cooperation in information sharing and exchange, appropriate technology in water resources development and management, flood warning and disaster management shall be initiated at the national, regional and global levels.

National Environment Commission
Royal Government of Bhutan
Thimphu, Bhutan
www.nec.gov.bt