

# Concept-Paper on Eco-efficient Water Infrastructure Policy in Nepal



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*Eco-Efficient Water Infrastructure Project*

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# Concept-Paper on Eco-efficient Water Infrastructure Policy in Nepal

## 1. Introduction

### *1.1 Background*

Water is a lifeline for all living beings of the earth. Water also plays an important role in the overall development of a nation. Nepal has abundance amount of water hidden in the form of snow and glaciers, under the ground, on the lakes, and in the form of flowing water in rivers, streams and rivulets. However, the mounting population pressure, mass poverty, visible climate change impacts on water . Nepal's unique geopolitical position make the water resources management in Nepal a complicated task. The population of Nepal in 1960 was 9, 691, 444, whereas in 2008 it has escalated to a figure of 28, 809, 526 (Data source: World Bank, World Development Indicators - Last updated April 21, 2010), almost 3 times in a period of 48 years. Due to rapid population growth, increasing urbanization, expanding development infrastructures, and the climate change impacts all are mounting enormous pressure, not only on Nepal's water quantity but on quality as well. Therefore, to address this important aspect, and for sustainable development, poverty alleviation and for the preservation of natural environment, it is of the essence that government's socio-economic development strategies should take into consideration the efficient and sustainable use, protection and conservation of water resources. At this stage eco-efficient water infrastructure seems to be one of the viable solutions to address this escalating pressure on ecology and socio-economic aspects.

### *1.2 Eco-efficient Concept for Water Infrastructure*

#### **1.2.1 Definition of Eco-Efficiency**

As defined by the World Business Commission on Sustainable Development (WBCSD): *Eco-efficiency is achieved by the delivery of competitively-priced goods and services that satisfy human needs and bring quality of life, while progressively reducing ecological impacts and resource intensity throughout the life-cycle to a level at least in line with the earth's estimated carrying capacity.* In short, it is concerned with creating more value with less impact. This definition implies that eco-efficiency (E/E) can bring about more added values with less environmental impacts. In this context, the term, 'eco' denotes both economical efficiency and ecological efficiency. Eco- efficient approaches for water infrastructure could be one of the best solutions for increasing water demands, worsening water pollution situations, and the climate change threats on water sector.

## 1.2.2 Key Components of Eco-efficient Approaches in Water Infrastructure

### *1.3 Objectives of the Concept paper*

- The application of eco-efficiency approaches in water infrastructure is complex. Basically different from traditional planning, it requires more complicated thinking methods and approaches and integrated planning which will be quite different from the traditional planning. First of all, eco-efficient approaches require policy makers to make planning based on water cycle, water infrastructure life cycle of planning, design, construction, operation and maintenance of water service facilities, and the surrounding eco-system which the infrastructures play in.
- Application of eco efficiency into water infrastructure development needs to integrate both dimensions of physical infrastructure aspects and non-physical or institutional aspects such as laws, regulations, regulatory programs, government bureaus, and civil society groups like environmental NGOs. The eco-efficient water infrastructure includes institutional arrangements and policy measures including relevant legal, economic and regulatory instruments to manage water resources in a sustainable manner.
- Another step to promote the idea of eco-efficiency in water infrastructure is to strengthen an integrated approach to water management issues. Fragmented approaches to water management issues had been criticized and blamed as one of the primary causes to trigger inefficient water resources development, allocation, water quality control, and flood prevention methods towards the end of the last century.
- Decentralized approaches should be included as one of the crucial components for promotion of eco-efficiency in water infrastructure development. In many countries in Asia, water resources planning and decision-making processes have been dominated by the elites located in capitals. Numerous cases show that such central planning system in water management has caused a deterioration of water supply and sanitation service levels and inefficient flood control measures in local areas. The virtue of decentralization in the water sector lies in the fact that the devolution of the managerial, administrative, and financial power to local areas can promote developmental policies and strategies appropriate for local social, economic and environmental conditions. This new mode of water policy also contributes to nurturing of sound governance structures that meet the demands of the public in localities. Decentralization can accelerate streamlining of the governmental bureaus at the center and redefine the roles and functions of diverse bureaus related to water management.
- The success of decentralization depends upon a clarification of the roles of local, regional, and national level institutions and the setup of efficient local level institutions for planning and decision-making. Without these foundations, there are several risks that might result in jeopardizing the decentralized system, such as the

reinforcement of local elite groups, anti-government movements in different ethnic and interest groups, the marginalization of less dynamic regions and the fragmentation of national unity (OECD, 2001).

- The importance of public participation in water policy-making and implementation has been widely discussed and accepted in the international water community. But public participation in water decision-making and implementation is still inadequately institutionalized. One of the fundamental causes to retard an institutionalization of public participation is a conventional approach of the bureaucrats who are in charge of water policy. The bureaucrats often believe that more engagement of the public might slow policy decision-making and implementation with unnecessary comments and interventions, which can cause an increase of transaction costs. The bureaucrats must outshine from this psychology.
- The main objective of the paper is to lay concrete policy directions for development of a national strategy or action plans on eco-efficient water infrastructure in Nepal.
- The second objective of the paper is to mainstream eco-efficiency concept into planning, implementation and monitoring process of water infrastructure development in Nepal through the presentation and facilitation of the concept policy paper.

## **2. Overview of the Nepal water sector**

### ***2.1 Water Resources status***

Nepal is rich in water resources. Water is regarded as the key strategic natural resources having the potential to be the catalyst for all round development and economic growth of the country. There are about 6000 rivers in Nepal having drainage area of 194,471 sq. kilometers, 74 % of which lies in Nepal only. There are 33 rivers having their drainage areas exceeding 1000 sq. km. Drainage density expressing the closeness of spacing of channels is about 0.3 km/sq. km. Nearly 14% of total country area is covered with snow and ice. There are 3,252 glaciers and 2,323 glacial lakes in Nepal Himalayas which are the storehouse of fresh water (UNEP/ICIMOD, 2001).

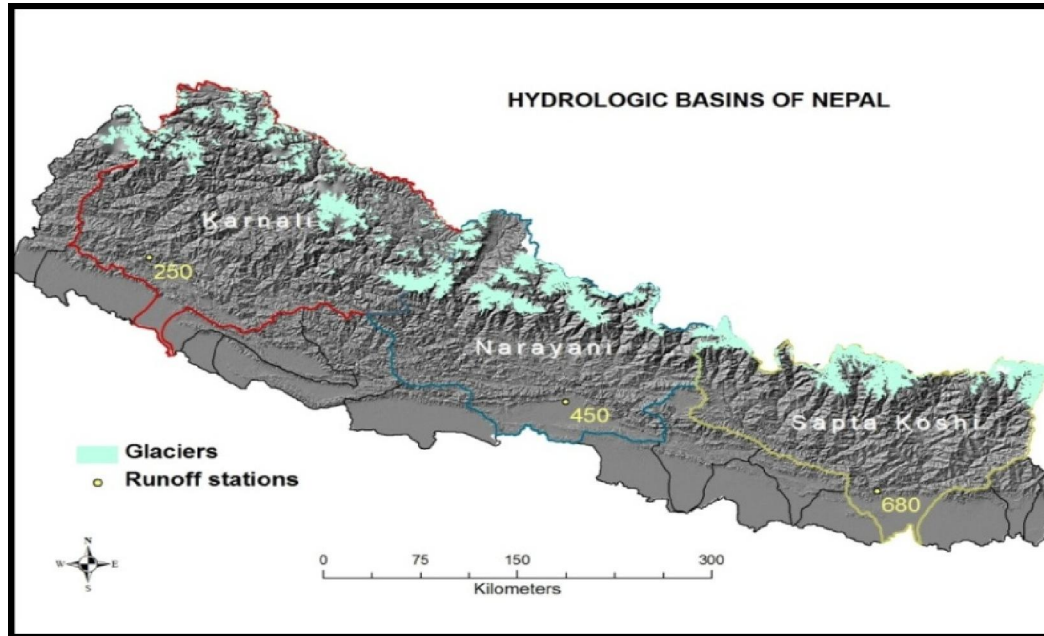


Figure 1: The river basins of the Nepal Himalaya, showing major areas of glacierization

(Source: World Bank, 2002)

The rivers of Nepal are characterized by a wide seasonal variation of flow. Generally the maximum flow occurs in the month of July-August and declining to their minimum flow occurs in February-March. About 80 percent of total flow occurs during five months (June to October) and 20 percent during the remaining months. All the rivers of Nepal flows to India on the south. The annual average precipitation is 1,530 mm. Annually eastern Nepal receives approximately 2,500 millimeters of rain; Kathmandu area about 1,420 millimeters; and western Nepal about 1,000 millimeters. However it is not distributed equally in time and space. 80 percent of the annual precipitation falls during the monsoon from June –September whereas remaining 20 percent falls in 8 months during the period October - May. The aridity increases with altitude and latitude, especially on the northern slopes, and reaches its climax in the inner Himalayan region and on the Tibetan Plateau.

Climate change has put in additional problems on water resources sector. The melting glaciers, change in precipitation trend: number of increasing days with more than 100 mm rainfall in 24 hours and long dry spell are some of the threats in this area.

Under these circumstances, Nepal needs a paradigm shift in water resource management to address the ever growing challenges on water resources. The development of Nepal’s water

resources could generate hydroelectric power, furnish water for irrigation, and supply water for domestic and industrial uses.

Table 1: Estimated Runoff from the rivers of Nepal

S.N.	River	Length ( km )	Drainage Area (km <sup>2</sup> )		Estimated Runoff (m <sup>3</sup> /sec)	
			Total	Nepal	From all Basins	From Nepal
1	Mahakali	223	15,260	5,410	730	260
2	Karnali	507	44,000	41,550	1440	1360
3	Babai	190	3,270	3,270	95	95
4	West Rapti	257	6,500	6,500	160	160
5	Narayani	332	34,690	30,090	1820	1570
6	Bagmati	163	3,610	3,610	180	180
7	Sapta Kosi	513	60,400	28,140	1670	780
8	Kankai	108	1,575	1,575	83	83
9	Other River		21,432	21,432	851	851
Total			1,91,007	1,41,577	7029	5339

Source: WECS

### 2.1.1 Existing Water Use

Although Nepal has 225 BCM of water available annually, only 15 BCM has so far been utilized for economic and social purposes. Out of which around 95.9% has been used for agriculture, around 3.8% for domestic purpose and only about 0.3% for industry (ADB/ICIMOD, 2006). 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-off- the-river schemes, have been virtually left untapped.

Manily, economy of country is based on agriculture; it contributes about 40% to GDP and provides employment to two-thirds of the population. However, agriculture practice is mainly based on rain fed system. The agriculture production in both rain fed as well as irrigated areas

are being badly affected due to droughts, flooding, erratic rainfall, and other extreme weather events.

Nepal has a cultivated area of 2,642,000 ha (18% of its land area), of which two third (1,766,000 ha) is potentially irrigable. At present, 42% of the cultivated area has irrigation of some sort of irrigation, but only 17% of cultivated area has year round irrigation.

In addition to surface water, a large volume of water is available in the shallow and deep aquifers which are estimated to be 8.8 BCM annually that can be used for irrigation and domestic water supplies.

The estimated hydropower potential of Nepal is 83,000 MW . And 45,610 MW have been identified as economically feasible. At present, Nepal Electricity Authority has a total installed electricity generation capacity of about 689 MW, of which the hydropower capacity is 632 MW.

Only about 72% of the country's population has access to basic water supply while only 25% of the whole population has sanitation facility.

The new type of the distributed water infrastructure should have the following multi-functions:

- Multipurpose – economically advantageous
- Protect natural disasters - flood, debris flow, and land slide
- Water supply – emergency water, in-stream flow, agricultural water
- Small-Hydropower with minimized environmental impacts
- Recreation
- Environmental and ecological protection (fish way, in-stream flow regulation, etc)

## ***2.2 Water Resources Strategy and National Water Plan***

### **2.2.1 Water Resources Strategy 2002**

Water Resources Strategy of Nepal acknowledges that every Nepali Citizen, now and in future, should have access to safe water for drinking and appropriate sanitation, as well as security.

Nepal's national goal has been defined as "living conditions of Nepali people are significantly improved in a sustainable manner". The Water Resources Strategy outputs will contribute to this goal through the achievement of short-, medium- and long-term purposes, defined as follows:

- Short-term (5-year) Purpose: Implementation of the comprehensive Water Resources Strategy provides tangible benefits to people in line with basic needs fulfillment, supported and managed by capable institutions involving all stakeholders.

- Medium-term (15-year) Purpose: The Water Resources Strategy is operationalized to provide substantial benefits to people for basic needs fulfillment 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 there are ten strategic outputs. These strategic outputs are categorized with reference to a particular aspect of water resources development: Security Uses and Mechanisms.

### **2.2.2 National Water Plan 2005**

In order to operationalize Water Resources Strategy of Nepal, a National Water Plan (NWP) was developed and endorsed by the government (2005). The objective of NWP is to contribute in a balance 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 implementation of NWP activities is to take place within the time frame of 5, 15 and 20 years. The action programs contained in the NWP are: 1) Management of major types of water induced disasters, 2) Improvement of water quality and watersheds, 3) Provide safe drinking water to 100% people of Nepal, 4) Provide irrigation facilities to 100% arable land, 5) Develop 4000MW of hydropower, 6) Provide water to 100% industry, navigation and tourism, 7) Enhance inland fisheries and increase the production to 87,000 MT per year, 8) Establish hydrometric stations to 370 at strategic places and disseminate the information, 9) Establish regional cooperation for water sharing fully, 10) Revise and refine the existing legal framework; develop policies, guidelines, norms and standards, 11) Restructure administrative institutions; revise and improve administrative mechanism.

NWP identified the following programs in different water related field: 1) Disaster, 2) Environmental Action Plan and Aquatic Ecosystem, 3) Water Supply and Sanitation, 4) Irrigation for Agriculture, and 5) Hydropower.

## ***2.3 Impacts of Climate change on water sector***

### **2.3.1 Water Stress: Too much, Too Little**

About 80% of annual precipitation occurs in monsoon period. Nearly 82% of annual river flow occurs in summer, six months from June to November (WECS, 2005). Even in areas where precipitation is intense, scarcity of water is common during dry period. So, the people had to

cope with either too much or too little water at different times of the year (Banskota and Chalise, 2000).

An analysis of about 30 years of observed temperature of Nepal has shown that maximum temperatures in Nepal are increasing at an alarming rate (Shrestha et al., 1999). Study carried out by the Department of Hydrology and Meteorology (DHM) shows that the maximum temperature increased by 1.8 °C in 32 years between 1975-2006, which is equal to about 0.06°C per year. The winter is more warmer compared to other seasons. The increasing trend of maximum temperature is a dominant feature of the country except for the western middle mountainous region. For minimum temperature, the decreasing trend is observed over the western and west of central mountainous regions and the eastern parts of the country. However, increasing trend is dominant over most of the regions.

Analysis of precipitation data from station records all over Nepal does not reveal any significant trends. However, an analysis of daily precipitation data for 46 years from 1961-2006 shows an increasing trend in precipitation extremes. About 73% stations (out of 26 total stations selected for the study) exhibited an increase in the annual count of days when precipitation is greater or equal to 50 mm (Baidya et al., 2008).

The rate of retreat glacier has accelerated in recent years. Accelerated melting of glaciers has caused creation of many new glacier lakes and expansion of existing ones. As a result, the risk of Glacial lake Outburst Flood (GLOF) has been increasing.

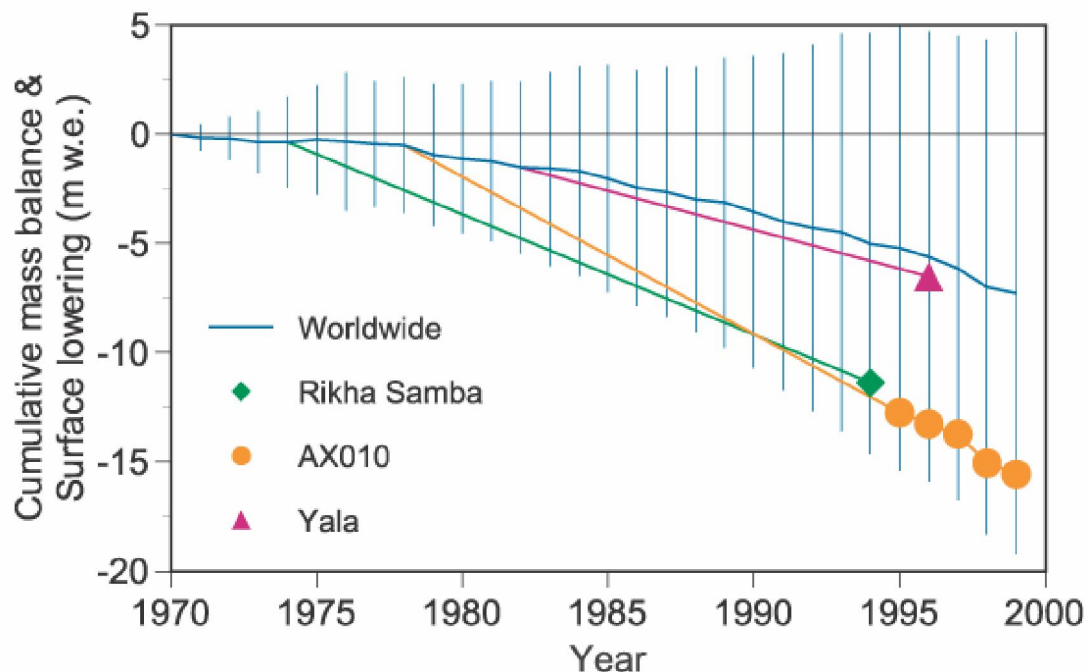


Figure 2: The pace of glacier shrinking

An analysis of river discharge for the period of 1947-1994 showed that the river discharge are in decreasing trend particularly during the low-flow season. In the snowfed rivers, the runoff first increases as more water is released by melting due to warming. As the snow and glacier volume gets smaller and the volume of melt-water reduces.

An increase in temperature by 3°C would cause an increase in annual irrigation water demand by 11%, while other parameters of water demand keeping constant (Chaulagain, 2007). Nepal is already experiencing water deficit during 4-5 months in non-monsoon season. Further warming may worsen the situation.

Almost all existing hydropower plants in Nepal are the run-off-river type with no associated storage dams, which make them more vulnerable to stream-flow variability. With an increase in temperature by 0.06°C per year, the theoretical hydropower potential of Nepal will rise by 5.7% by 2030 AD but will decrease by 28% by the end of this century (Chaulagain, 2007).

It is widely acknowledged that climate change affects the water sector most seriously and the problem of either too much or too little water in sustainable management would exacerbate. Rising temperatures have caused glaciers to melt and retreat faster and increased risks of GLOF events. Similarly, increased intense precipitation events have resulted more floods, landslides and sedimentation. There has been decrease in low flows during dry seasons exacerbating water stresses.

Recent evidences in water resources show that spring peak discharge is occurring earlier in rivers, affected by snow and glacier melt. Higher temperatures lead to higher crop evaporative demand causing increased irrigation water requirements. Freshwater availability in Nepal is projected to decrease due to climate change. Nepal is already facing water shortages during dry season despite of abundant rainfall during rainy season.

Peak melting season in the Himalayas coincides with the summer monsoon season. Therefore, any intensification of monsoon or accelerated melting would contribute to increased summer runoff that would ultimately result in increased flood disasters. The increase in temperature would shift the snowline upward and reduces the capacity of natural reservoir, which would increase the risk of flood in the Himalayan region. The projected impact of climate change indicates an increase in monsoon flows and a decrease in non-monsoon flows. The impacts of climate change in river flows in shorter term would be more pronounced for rain-fed rivers than for snow-fed ones because the warming effect will be masked by the melt-water contribution of snow-fed rivers. For the longer-term, the melt-water component might go on decreasing after the melting glaciers disappear.

It is likely that climate change will increase water induced extreme events in terms of magnitude and frequency. Climate change is very likely to increase the intense precipitation events and prolong the drought period. Intense precipitation events results in the land degradation, landslides, damage to infrastructures and reduced time for groundwater recharge. Longer or persistent droughts lead to decline in agricultural products, decrease in water resources availability and degradation in water quality.

Marked reduction in winter precipitation and growing frequency of winter drought has deteriorated the situation of water supply particularly in the last 10 years. In 2008, the weaker monsoon followed the historical winter drought of six months. This coincided with historical wildfires which are visible to satellite images. Media reports from all over the country including

rural and remote parts of the villages show that water scarcity has deeper impacts on livelihoods and environment.

### **2.3.2 Climate change hazard, risk and vulnerability in Nepal: the physical and socio-economic environment**

Nepal is already in high risk to natural disasters and is likely to be more vulnerable to climate change. Agriculture is one of the most susceptible sectors to climate change. The poor, marginalized and disadvantaged groups, and inaccessible areas are likely to be affected more since their capacity to cope with the changing natural environment including water resource availability and quality is very weak.

## **3.Eco-efficient Water Infrastructure in Nepal**

### **➤ Rain water harvesting**

The rural communities with traditional knowledge and technical expertise practice this rainwater harvesting since long ago. The local people themselves initiate this practice to fulfill their basic water need during dry season. However; this technique is not practiced nationwide so it high time to think about to replicate this environmental friendly, sustainable technology to address the even increasing demand of growing population.

If water is used efficiently, enough water can be collected through this method which can last whole year. Rooftop rainwater harvesting involves networking of pipes in roofs so that rain water falling on surface can be channeled to central accumulation reservoir.

In Nepal also the practice of rainwater harvesting is on going, which is seen in many places. For e.g.: at the Trichandra Multiple College, the rainwater harvesting system is installed with the support from various organizations. The college being at the centre of Kathmandu and near to Rani pokhari, pond, rain water harvesting of this college provide water for Rani pokhari as well and fulfill the water demand of college students. The project is taken as an good initiative to motivate other institution also.

While looking into the Kathmandu valley's drinking water situation, the demand is 200 million liters per day (MLD) but the water authority can supply only 90 MLD( 45%) during dry season and 120 MLD (60%) during wet season. So valley residents are not getting sufficient water supply and compelled to extract water from the main line using electric pumps which further deepens the water shortage in long run. The current plan to reform the water situation in Kathmandu is to bring water from Melamchi, a plan which will take several years to finalize. Hence the rain water harvesting is seems to be most appropriate alternative to address today's water demand.

Rain water harvesting is being practiced from centuries and we should also be able to take benefit from it. Several organizations like UN-Habitat in coordination with government bodies and other private institutions launched the innovative rainwater harvesting promotion program

(RWHPP) by setting model RWH systems and disseminating information to the general public about their effectiveness and advantages.

In few years, the awareness program of the RWHPP has had a considerable impact on both government policy makers to the ordinary people. More than 500 RWH have been installed both at institutional and individual level which can be taken as a good achievement.

Although the residents of Kathmandu valley are attracted towards this RWH, they still are skeptical on its usage as for drinking purpose. So to illuminate their fear more insightful awareness programs are required and more information about treatment of rainwater must be disseminated.

➤ **Rainwater Harvesting as the only option for livelihood enhancement for the Manung VDC (A case of Tanahun District of West Nepal)**

Nepal is facing acute water shortage although the country is considered to be one of the richest countries in the world in terms of water resource. While looking into the case of Manung VDC, livestock rearing is the major livelihood option of the community where almost every household has livestock that demand huge amount of water for sustaining and good quality yield. Besides, people plant crops only once a year due to lack of irrigation facility. So the water stress is comes out as the major problem of this VDC.

The major and only source of water in Manung VDC is rainwater and natural springs at some places. Rainwater harvesting is a good alternative to collect water to fed cattle and increase milk production and enhance livelihood of people. The management strategies of water resources in the Manung VDC include; storage tank management, management of watershed, management of distribution, management of drainage and selection of suitable crops requiring less water for hilly region. Rainwater harvesting is not new for Nepal, people using this system from long time for irrigation of crops, and fulfilling daily water demand. Government should realize the importance of this technique and form targeted policies for rainwater harvesting in community level.

➤ **Water Mill**

In Nepal over 25,000 water mills (ghattas) are operating throughout remote are ( Center for Rural Technology) with power output ranging between 200 - 500 Watts. Traditionally this power is only harnessed for the ghatta's sole purpose, grain grinding.

The fundamentals of a ghatta are fairly basic. Water is diverted from a stream or river and flows down a chute towards the ghatta's turbine. The vertical shaft of the turbine runs up through the floor of the ghatta house and turns the top stone of a pair of grinding stones. Grain is stored above the stone in a suspended woven basket. It slowly falls out through a feeder mechanism at the bottom of the basket. The top stone has a hole carved in its center all the way through it. Grain from the feeder mechanism falls down through this hole, and is then ground between the pair of stones.

Ghattas are made from local materials, so naturally each is to some extent unique. Although they have the features outlined above, the sizes or materials can significantly vary from location to location.

Ghatta houses vary with the building materials as well. They generally are constructed exactly the way neighboring houses are built. The power output of the ghatta also varies not only from place to place, but season to season as well. Typically, however, the flow rate of water varies from about 40 to 100 liters per second.

#### ➤ **Micro Irrigation Technology**

In Nepal, Micro irrigation technologies ( MIT) mostly are used in water scarce areas. MIT are used water more efficiently in irrigated agricultural. The micro irrigation technologies increases productivity, enhance food security of household and raise incomes of each households. The MIT system includes low cost system such as drip and sprinklers irrigation system. Generally, the use of MIT gives significant yield improvement over traditional irrigation practices.

## **4.Existing Institutional and Legal Framework**

### ***4.1 Institutional Framework***

The water related institutional structure in Nepal can be functionally categorized in four groups- (i) planning, policy making and coordination (ii) implementation (iii) operation-level and (iv) regulatory. The existing organizational structures currently in operation in the water sector are presented below. The existing central level water resources development related institutions are given in Appendix.

#### **4.1.1 National Development Council (NDC)**

National Development Council (NDC) is a high level policy and planning body under the chairmanship of the Prime Minister. Its membership is drawn from various walks of life including political circle, social workers, technocrats and bureaucrats. The Council guides the National Planning Commission in the formulation of development policy and periodic plans.

#### **4.1.2 National Planning Commission (NPC)**

National Planning Commission (NPC) is the apex planning body for formulating development plans and policies of the country under the directives of the National Development Council. The National Planning Commission is chaired by the Prime Minister. It has jurisdiction over all ministries and public sector agencies to formulate periodic and annual plans and oversee its implementation in an advisory capacity. With a view to formulating development budget, it explores and allocates resources for economic development and works as a central agency for monitoring and evaluation of development plans, policies and programmes. Besides, it facilitates the implementation of development policies and programmes.

### 4.1.3 National Water Resources Development Council

The National Water Resources Development Council (NWRDC) is a high-level water resources policy and coordination institution chaired by the Prime Minister himself. The membership of the Council is broad-based with representatives from political parties and includes leader of the opposition party, and people from outside the government. It is a political forum for discussion on national issues relating to water resources with a view to building national consensus for its development. The Water and Energy Commission Secretariat, functions as its Secretariat.

### 4.1.4 Water and Energy Commission (WEC)

The Government of Nepal established Water and Energy Commission (WEC) in 1975 with the objective of developing the water and energy resources in an integrated and accelerated manner. Water and Energy Commission Secretariat (WECS) was established in 1981 as a permanent secretariat of WEC. The primary responsibility of WECS is to assist the Ministry of Energy, Ministry of Irrigation and other related agencies in the formulation of policies and planning of projects in the water and energy resources sector. The objectives and mandates of WEC and WECS have been revised and modified a number of times since their establishment. The Water and Energy Commission (WEC) is chaired by the Minister for Energy and includes as members secretaries of 12 ministries and five representatives from outside the government. The composition is given below:

1. Ministry/ State ministry for Energy	Chairperson
2. Member, National Planning Commission (Water Resources)	Member
3. Secretary, Ministry of Energy	Member
4. Secretary, Ministry of Irrigation	Member
5. Secretary, Ministry of Finance	Member
6. Secretary, Ministry of Physical Planning and Works	Member
7. Secretary, Ministry of Industry, Commerce and Supplies	Member
8. Secretary, Ministry of Law, Justice and Parliamentary Affairs	Member
9. Secretary, Ministry of Agriculture and Cooperatives	Member
10. Secretary, Ministry of Foreign Affairs	Member
11. Secretary, Ministry of Environment, Science and Technology	Member
12. Secretary, Ministry of Forest and Soil Conservation	Member
13. Secretary, Ministry of Local Development	Member
14. Two persons nominated by Government from known water Resources and energy specialist from non-Government sector	Member
15. Dean Institute of Engineering, TU	Member
16. President Nepal Engineers' Association	Member
17. Representative, Federation of Nepalese Chamber of Commerce and Industry	Member
18. Secretary Water and Energy Commission Secretariat	Member Secretary

## **Mandates**

### a) General:

- To formulate necessary policies and strategies for conducting study, research, survey and analysis on various aspects of water resources and energy development in keeping with the priorities and targets of Government of Nepal.
- To enact the necessary laws pertaining to the development of water resources and energy.
- To establish coordination among national and sectoral policies relating to water resources and energy sector.
- Identify the viable power projects and make an analysis of bilateral and multilateral projects relating to the development of water resources and energy.

### b) Mandates by Water Resources Strategy (WRS), 2002

- Improve the application of the agreed strategic planning concept so that water sector issues can be addressed in an integrated manner;
- Coordinate relevant line ministries and departments to achieve integrated water resources management objectives;
- Enable sustainable development of water resources to benefit more people;
- Promote and advance river basin planning concepts to optimize water use benefits and minimize conflicts; and
- Monitor water sector development and management more closely and independently commensurate with the agreed policy and strategy.

### c) Mandates by National Water Plan (NWP), 2005

- Act as an apex institution to coordinate national level planning to the entire water resources sector;
- Advise NPC on budget allocation
- Provide techno-economic clearance to water resources projects which shall be mandatory for:
  - Hydropower projects of more than 10 MW installed capacity;
  - Irrigation projects of more than 5,000 ha command area;
  - Drinking water supply projects covering more than 100,000 population
  - 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;
  - Projects designed for multipurpose use;
  - Projects with trans-boundary implications; and
  - Projects involving inter-basin water transfer.

WECS was established to provide technical and administrative support to the WEC and carry out its decisions. It also works as the secretariat of the NWRDC. The government has also designated the WECS as the national water-planning unit.

#### **4.1.5 Environment Protection Council (EPC)**

The Environment Protection Council (EPC) is a high-level body created in 1992 and chaired by the Prime Minister. The functions of the Council are to provide policy guidelines, advice to the government and to maintain coordination between various agencies of the government related to the management and protection of environment and the preparation of working procedures and the implementation of policies in pursuit of the following objectives:

- Effective management of natural and physical resources;
- The achievement of sustainability in the capacity of all Nepalese by maintaining a balance as well as coordination between development efforts and environmental protection;
- The provision of support to efforts for sustainable development through the use, management, development and protection of physical resources and heritage, taking into consideration the social, economic and cultural needs and opportunities of the present and future generations;
- The timely identification of likely adverse environmental impacts from population growth, haphazard settlement and development projects, and the prevention and mitigation of such impacts;
- The development of a national system for environmental planning, environmental impact assessment and evaluation, pollution control and the protection of the national heritage;
- The utilization, development, management and protection of the capacity to regenerate and recycle physical resources without inflicting adverse impacts on the environment;
- The implementation of special measures for the protection and promotion of rare and endangered national wildlife, plant species, biological diversity, the genetic pool, natural and cultural beauty and sites, and environmentally threatened areas, in accordance with their importance;
- The preparation and improvement of the environment-related legal framework;
- The development and coordination of activities undertaken by governmental agencies and non-governmental organizations (NGOs) for the effective implementation of environmentally-related laws and policies;
- The establishment and operation of an environmental protection fund;
- The dissemination of information, and the improvement of education and public awareness related to the environment;
- The development of human resources in the area of the environment.

The Ministry of Environment serves as the EPC secretariat.

#### **4.1.6 Ministries related to Water Resources**

The ministries directly related with water resources include: Ministry of Energy, Ministry of Irrigation, Ministry of Physical Planning and Works, Ministry of Science and Technology, Ministry of Local Development, Ministry of Environment.

The original Ministry of Water Resources was recently divided into two - Ministry of Energy (MOE) and Ministry of Irrigation (MOI) which are responsible for formulation of policy, plans and programs relating to energy and irrigation sub-sectors respectively. MoE grants license for survey, generation and distribution of electricity. The Ministry of Physical Planning and Works (MoPPW) has the mandate for developing policy, plans and programs relating to water supply and sanitation, among other things. It is responsible for assuring quality of water supply. The Ministry of Environment (MoE) assumes a comprehensive role in the management and conservation of the environment under the Environment Protection Act, 1996 .

The jurisdiction of the Ministry of Local Development (MoLD) include formulation of policy on decentralization, implementation of local development programs and monitoring, coordination of local development programs, mobilization of local resources including human resources, and training and development of human resources.

The Ministry of Forest and Soil Conservation (MoFSC) is related with the development, management and protection of the watersheds. The Department of Soil Conservation and Watershed Management (DSCWM) has the responsibility of controlling and regulating floods and slides to protect soil erosion.

#### **4.1.7 Implementation-Level Institutions**

The Department of Irrigation (DoI) under the Ministry of Irrigation is responsible for the development and management of surface and groundwater. The functions of the Department are (a) planning, design and implementation of major and minor irrigation systems; and (b) sustained operation and management of the completed systems. The Department also plays a major role in designing the irrigation policy.

The Department of Hydrology and Meteorology (DHM) has been placed under the Ministry of Environment. The department provides information on the resource base of water resources in the country. The collection, analysis and publication of hydrological and meteorological data are vital to and closely related with water resources.

Department of Electricity Development (DoED), previously Electricity Development Center (EDC) assists the Ministry of Energy in the regulation of power sub- sector including licensing, promotion of private sector, inspection and quality control, study of river basins, conduct feasibility studies and help select projects for private sector financing and development. Recently it has been given a status of a department.

The Department of Water Supply and Sanitation (DWSS) is the lead implementing agency in water supply sub-sector. A Director General heads the department. The DWSS is responsible for all rural water supply and sanitation projects. Its mandate is to formulate plans and programs for the development of this sub-sector.

The Department of Local Infrastructure Development and Agriculture Roads (DoLIDAR) is to provide technical guidance and direction to the District Technical Office (DTO), which is under the administrative control span of District Development Committee.

#### **4.1.8 Operational Level Institutions**

Nepal Electricity Authority (NEA) is a public corporation with the mandate for power generation, transmission and distribution throughout Nepal and engages in power exchange with

India. It is now required to work with private sector entities. The Minister of Energy chairs the Board of the NEA.

The Nepal Water Supply Corporation (NWSC) has been established under the Nepal Water Supply Corporation Act, 2046. The Secretary of the MoPPW chairs the Board of Directors of the Corporation. The NWSC Act provides the Corporation with the mandate to plan, construct and operate water supply systems under its jurisdiction. The water supply and sewerage within the Kathmandu Valley is now managed by a newly established Kathmandu Upatyaka Khanepani Limited, a newly established public-private sector company.

**Local Government Bodies:** Local institutions include District Development Committee (DDCs), Village Development Committees (VDCs) and municipalities. These local bodies look after local-level development projects and service delivery at the local level. Under the Local Self-Governance Act, 1999, DDCs are expected to take over the responsibility of the district-level offices of sectoral ministries.

**Water Users' Groups/Associations:** Following the government's strategy of involving the beneficiaries and the people for planning, implementation, management and operation of water resources projects.

#### **4.1.9 Regulatory Institutions**

As the government has opted for a policy approach of getting the community organizations, NGOs and the private sector to gradually take over the functions of the public bureaucracy in producing goods and delivery of services .

The Water Resources Act, 1992 (WRA) and the related regulations provide for a set of instruments for regulation of the use of water. As the ownership of water resources is vested on the government, the use of water is regulated through a system of permits. The District Water Resources Committee (DWRC) in each of the 75 districts is empowered to grant license for their utilization.

The Electricity Tariff Fixation Commission (ETFC) under the Electricity Act, 1992 has been established for fixing the tariff of electricity. The tariff is fixed after consideration of various factors including the rate of depreciation, return for the investment, royalty, operation cost and the consumer price index. The tariff is revised as and when necessary.

The government has also established a new water supply and sewerage regulatory agency- the Water Supply Tariff Fixation Committee- which is responsible for the economic regulation of the water supply sub-sector.

## **4.2 *Water law/policy, key agencies and responsibilities***

So far there have been sub-sectoral policies related with development and uses of water but there has not been any comprehensive Water Resources Policy to guide or incorporate the sub-sectoral development requirements. The main features of the major sub-sectoral policies related with water sub-sector's uses and development are summarized in the following sub-sections.

### **4.2.1 Water Resources Strategy and National Water Plan**

The Water Resources Strategy (WRS) was formulated in 2003. The specific objectives and the policy principles followed are given below.

**Specific objectives adopted for WRS include:**

- Help reduce the incidence of poverty.
- Provide access to safe and adequate drinking water and sanitation for ensuring health security.
- Increase agricultural production ensuring the nation's food security.
- Generate hydropower to satisfy national energy requirements and to allow for export of surplus energy.
- Protect the environment and sustain the biodiversity of natural habitat.

**Policy principles that have guided Nepal's water sector during WRS include:**

- Development and management of water resources shall be undertaken in a holistic, systematic manner, relying on integrated water resources management.
- Water utilization shall be sustainable to ensure 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 (e.g., 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 the stakeholders shall constitute the basis of water sector development.
- Sharing of water resource benefits among the co-riparian countries shall be on an equitable basis for mutual benefit.
- Institutional and legal frameworks for coordination and transparency shall be an essential feature of water sector management.

The ten strategic outputs were identified by the WRS and performance indicators were identified for 5-, 15- and 25-year timeframes. Each output is categorized with reference to a particular aspect of water resources development:

- Security (Outputs 1 and 2) – security from water-induced impacts and security of water supply;
- Uses (Outputs 3 to 6) – types of water use (e.g., domestic water supply and sanitation; irrigation; hydropower; and other economic uses of water such as for industry, tourism, fisheries and navigation); and
- Mechanisms (Outputs 7 to 10) – mechanisms (i.e., regional cooperation, development of water-related information systems and appropriate regulatory frameworks, provision of

appropriate institutional support) that enable the benefits of sustainable water use to be realized, enhanced or maximized.

The National Water Plan (NWP) was prepared based on the Water Resources Strategy in 2005. The major doctrines of the Water Plan are integration, co-ordination, decentralization, popular participation and implementation of water related programs within a framework of good governance, equitable distribution and sustainable development. The National Water Plan then presents the Action Plan and the required Investments to meet the sub-sectoral goals and targets of National Water Resources Strategy.

#### **4.2.2 Irrigation Policy**

The irrigation policies were formulated at first during 1993, and were amended during 1997. These policies have been amended again in 2003. The successive reforms in irrigation policies have underlined the main objectives as follows:

##### **Objectives**

- (1) To make an optimal use of water resources in providing round the year irrigation services to the cultivable areas as far as feasible.
- (2) To encourage and enhance the participation of the beneficiary farmers in the sustainable management of the irrigation system.
- (3) To enhance the institutional capacity of the government, non-government, farmers and beneficiaries related with development of the irrigation sector.

#### **4.2.3 Hydro-power Policy**

The hydropower policy of 1993 was amended in 2001 to bring it up to date based on the experiences gained. The main objectives of the hydropower development could briefly be enumerated as:

- (1) To make an optimal use of water resources of the country and produce reliable and dependable electricity at affordable cost in the country.
- (2) To expand electrification to contribute to achieving the national development goal including rural electrification.
- (3) To develop hydropower as a source of clean energy for export to the regional market based on the potentials of the country.

The major features of the policy guidelines are:

- (1) Expand hydropower development to meet the need of the country.
- (2) Encourage competition in production of electricity including the implementation of storage projects by attracting foreign and domestic resources.
- (3) Build Own-Operate-Transfer (BOOT) mode of project development will be encouraged in the hydropower sector.

- (4) Mobilization of resources through creation of Electricity Development Fund, and Rural Electricity Development will be made.
- (5) Small and micro hydro projects will be encouraged to meet needs of the remote rural areas of the country.
- (6) The present Electricity Tariff Fixation Commission will be developed into an Electricity Agency for quality, compliance, monitoring of services and guide the electricity pricing and purchase agreements.
- (7) The policy of unbundling of the present NEA operation for encouraging private sector competition in electricity generation and distribution through the availability of independent wheeling services and grid code is also under implementation.
- (8) It also encourages the participation of local level cooperatives and consumers groups in the operation and distribution of electricity especially in the rural areas.

#### **4.2.4 Drinking Water Supply Policy**

The broad objective and principle policy of the drinking water and sanitation sector is to provide and ensure safe, convenient and adequate water supply to all Nepalese with sanitation as its integral component with specific focus on disadvantaged groups to reduce incidence of water related diseases, and lessen sufferings and drudgery of women and children who are traditionally involved with collecting water and carrying domestic sanitation and hygiene. The major policy guidelines to this effect could be summarized as presented hereunder:

- (1) The long term perspective objectives will be to provide high class service quality to 25% of the population, while 60% and 15% of the population will receive medium and basic level services based on the standard being maintained on composite index composed of quantity, quality, supply time, reliability, etc.
- (2) Promotion of community education and awareness programmes for enhancing capabilities of the communities and empowerment for obtaining benefits effectively from water supply and sanitation (WSS) programs.
- (3) Integration of drinking water supply as a component of other water resources development projects wherever feasible.
- (4) Redefine the role and responsibilities of the central, district and local organizations so as to decrease direct involvement of HMG and rather enhance its role as a facilitator in implementation of water supply and sanitation, thus strengthening local institutions such as DDC, VDC, and CBOs for decentralized WSS service delivery.
- (5) Establishment of autonomous and self-sustaining competent utilities to deliver urban water supply services and improvement of the institutional framework for utilities in general.
- (6) Encourage women's participation in all aspects of water supply planning, management and O&M.
- (7) Improvement and establishment of effective water rights administration for facilitating in allocation of such water rights.

- (8) Establishment of water quality regulatory body for quality surveillance and water tariff fixation.
- (9) While the rural water supply schemes would be implemented with the community participation the private sector involvement in the development and operation of water supply will be encouraged in the municipalities.
- (10) The drinking water projects/schemes will be implemented with a policy of cost recovery/sharing. Mainly, the rural water schemes will be implemented with a provision of O&M cost being contributed by the beneficiaries, while in the urban areas; additionally the investment cost also would be recovered.
- (11) Further, Municipality Drinking Water Supply Act will be enacted for involving the private sector in the development and management of water supply in the urban areas.

#### **4.2.5 Water Induced Disaster Prevention**

Given the geo-climatic conditions of the country, immediate and long term policy measures need to be formulated and mitigation measures need to be undertaken to lessen the impacts, respond to emergency measures and organize relief measures in the event of water induced disasters. The long-term perspective objective is to institutionalize the management of water induced disasters through the coordinated efforts for effective control and prevention. The strategic policies are:

- (1) Enhance institutional capabilities for managing water induced disaster for the first five years of the National Water Plan, i.e., during the Tenth Plan.
- (2) During this period the program envisages to prepare water induced disaster management policy, plans and legal framework.
- (3) Initiate measures to the Nepal-India Border inundation committee/ sub-committee.
- (4) The perspective as envisaged by the National Water Strategy is to enhance institutional capacity such that the water induced disaster management system becomes fully operational, effective and responsive to peoples needs. This system should also be able to address to the needs of the marginalized people who are generally more vulnerable to such calamities and disasters.

### **4.3 Legal Framework**

The major legal frameworks related with water resource development that are based on the above mentioned policies as follows.

- Water Resources Act 1992
- Water Resources Regulations 1993
- Irrigation Regulations 2056
- Drinking Water Regulations
- Nepal Electricity Authority Act 2041

- Hydro Resources Act 2049
- Hydro Resources Regulation 2050
- Disaster Relief Act 2039
- Nepal Water Supply Corporation Act
- Local Self Governance Act 2055
- Local Self Governance Regulation 2056

## **5.Integration of Eco-Efficient water Structures**

The core idea of eco-efficiency, ‘more value with less impact (on the environment)’, has proven to be also applicable in management of water infrastructure. The eco-efficient water infrastructure indicates physical infrastructure in water and sanitation services that adopt the sustainable processes of design, construction, operation and maintenance with less environmental impacts. The eco-efficient water infrastructure also includes institutional arrangements and policy measures that support water supply and sanitation services to entail an optimal level of water utilization and a less burden to limited water resources. This idea focuses on the life cycle of planning, design, construction, operation and maintenance of water services facilities but also of institutional measures including relevant legal, economic and regulatory instruments to manage water resources in a sustainable manner.

### ***5.1 Challenges and Actions by Key Water Bodies and Agencies***

The current status of water resources utilization in Nepal is low although the availability of the water resources in the country can be said to be high. However, the spatial and temporal variation of the available water resources does not match the demand of the water for various human and environmental needs. The problems of “too little”, “too much” and “too dirty” water is prevalent. Lack of both “physical infrastructure” and “non-physical infrastructure” has still deteriorated the situation.

The key challenges and the actions required from water bodies and agencies could be summarized as follows:

- 1) As stressed in the NWRS and NWP, an apex body like the Water and Energy Commission Secretariat (WECS) needs to play the role of a national coordinator for water resources utilization but which has not been followed in practice through changes in the legal framework.
- 2) River basin has been recognized as the fundamental planning unit. Hence, River Basin Organizations (RBOs) as envisaged in the NWRS and NWP should be urgently established so that eco-efficient infrastructures can be created.
- 3) The development targets such as recently government pronounced 37,000 MW of hydropower generation in the next 20 years or providing year round irrigation or adequate drinking water supply and sanitation coverage requires dedicated institutions. WECS as a focal planning government agency need to take control of planning however WECS has not been able to carry out the task owing to legal, financial and HRD constraints.

- 4) The challenges and opportunities that will come from the federal structure of the country should be management by the water bodies and agencies.
- 5) As Water Resources Development will be a key development goal of the country, the water agencies need to be strengthened to make strong decision to develop interventions in a sustainable manner with the minimum environmental and social consequences. Huge physical infrastructures such as dams, inter-basin diversions, large irrigation projects, flood control measures etc will be necessary to meet the development. While the reasonable and rational logic and demand of these bodies should be honored, the institutions should be able to handle other opposition in a firm manner. The options of not doing the project, most of the time, have more serious environmental and social consequences than implementing the project.

## 5.2 Challenges faced for integration of Eco-efficiency infrastructure

The following figure shows that eco-efficient water infrastructure includes both physical and non-physical infrastructure.

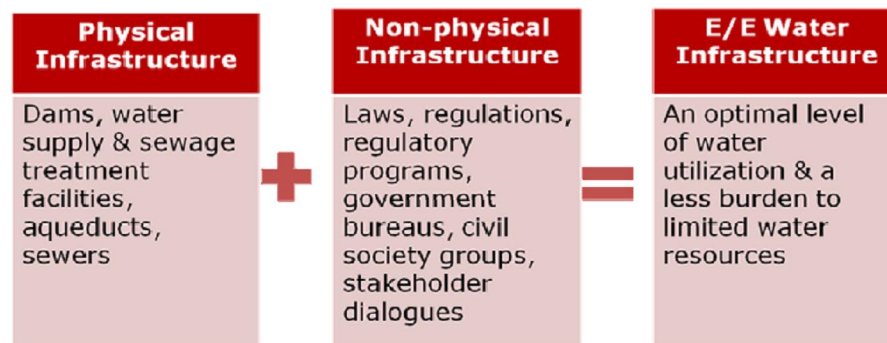


Figure 2: Eco-efficiency Infrastructure  
Source: Seungho and Bok-sik, 2009

The major challenges faced for the eco-friendly infrastructure may be summarized as follows:

- 1) Mobilization of the financial resources perhaps is the biggest challenge to develop the physical infrastructure. Private sector involvement is a key funding these water infrastructures. However, due to the current political transition in the country, private sector, both national and international, has been reluctant to invest in the country. The government therefore has promoted public-private partnership which hopes to mitigation some of the risks that the private sector may face.
- 2) Capacity of the institutions is another challenge for the development of eco-friendly infrastructures.
- 3) Lack of long term reliable data is another challenge. This has now been exacerbated by the impacts of climate change and other anthropogenic factors.
- 4) The restructuring of the water agencies have been proposed considering integration, coordination, decentralization, popular participation and implementation in the NWP. This is another challenge the water agencies currently face.

- 5) Although the principles of Integrated Water Resources Management (IWRM) have been accepted, the country still lacks a coherent Water Policy and subsequent legal and regulatory framework to implement it.
- 6) The separation of policy, implementation and regulatory functions of the water institutions is still lacking. The regulatory bodies like the ETFC and the WSTFC need to regulate the sector to ensure eco-friendly development while ensuring consumer rights and environmental sustainability.

### ***5.3 Framework for the promotion of eco-efficient water infrastructure***

Two key policy principles that guided the Water Resources Strategy (WRS) and National Water Plan (NWP) among others were:

*"Development and management of water resources shall be undertaken in a holistic and systematic manner, relying on Integrated Water Resources Management (IWRM), and.*

*"Water utilization shall be sustainable to ensure conservation of the resources and protection of the environment. Each river basin system shall be managed holistically."*

The Global Water Partnership (GWP) defines IWRM as a process which promotes the coordinated development and management of water, land and related resources in order to maximize the resultant economic and social welfare in an equitable manner without compromising the sustainability of vital ecosystems. It is now advocated that we need to move from IWRM to “adaptive” water management. Adaptive management recognizes that water resources systems operate in an uncertain environment and, hence, there is a need for flexible management tools that can adapt to change and uncertainty.

The overriding criteria for IWRM and/or “adaptive” water management are:

- **Economic Efficiency in Water Use:** Because of the increasing demand on water and financial resources, and the finite and vulnerable nature of water as a resource, water must be used with maximum efficiency.
- **Social Equity:** The basic right of all people to have access to water of adequate quantity and quality for the sustenance of human well-being must be universally recognized.
- **Environmental sustainability:** The present use of the resource should be managed in a way that does not undermine the life support system, thereby compromising the use by the future generation of the same resource
- **Adaptability:** The water resources policies, programs and plans need to be “adaptive” (as against “rigid”) in response to additional data collection, uncertainty and desired outcomes. There is a need to develop and implement “no regret” projects and policies even in the worst case scenarios of climate change and other uncertainties.

#### **Guiding Principles in Integrating the Eco efficiency into Water**

- Integrated planning with other infrastructures

- Decentralized approaches for water infrastructure development together with allocation of resource and capacity buildings to local governments/stakeholders
- Development of easy participatory mechanism for active participation of the stakeholders and ownership.
- Balanced planning in the development of physical as well as non-physical water infrastructure.
- Integrated approach to link social and economic development with protection of natural water resources and ecosystems that is decentralized, participatory, community-based and conducted at the most appropriate level.
- Development of institutional and legal framework.
- Monitoring and feedback mechanism.
- Capacity building programmes (Institutions, Stakeholders, HRD)

The action plans for promoting eco-efficient water institutions can be as follows (NWP, 2006):

- Mainstreaming IWRM and River Basin Concept
- Development of River Basin Plans
- Appropriate Institution for water resources development in a river basin planning framework

#### ***5.4 Good Practices***

Eco-efficient planning must be based on precise understanding of the components of hydrological cycle, decentralized approaches, demand management, design and IT technology for water reuse and recycling, public-private cooperation, active participation of stakeholders in the planning process, while emphasizing the promotion of innovation. Good practices in the field of water sector needs to be addressed mainly on projects such as water management and planning, rehabilitation of lakes and rivers, rainwater harvesting and storm-water management, and small hydropower project.

Good practices include Innovative Projects, having positive and tangible impact to communities and apparently the environment, economical in long-term perspective, and having less impact on the society.

The good practices also have their uniqueness in terms of non-physical infrastructure development such as legislative changes, organization and management of the project.

##### ***5.4.1 Cases of good practices on eco-efficient water infrastructure:***

The green growth concept is emerging as a new concept on maintaining sound growth with minimum use of energy and resources with three major goals; new national development, enhancement in the quality of life of the public and contribute to the international efforts of the community to tackle climate change.

The average annual rainfall in Korea is higher than the world average yet they faced the problems like drought and flooding. So they made a vision of sustainable water resources management for human and environment with the priorities like acquisition of sufficient water resources, construction of water courses with conserving ecosystem, preparation of database and international cooperation and establishment of natural infrastructure with enhanced flood control capacity. To cope with the damages caused by flood and drought, Korea launched the four major river restoration projects which have the objective of reducing damage, supply water adequately, create recreational spaces in the river fronts, generate new renewable energy with photovoltaic and hydropower and reduce carbon dioxide level through eco-wetland and river forest development.

Similarly the active, beautiful and clean (ABS) program in Singapore, which was initiated with the goal to develop the water bodies in other functional use except their usual utilization, to gather knowledge, expertise from the 3P i.e. people-public and private concept and to enrich the community with water issues and instill stewardship.

The establishment of NEWater in Singapore is another good example. 'NEWater' is referred to as "treated water that has undergone stringent purification and treatment process using advanced dual-membrane (microfiltration and reverse osmosis) and ultraviolet technologies" NEWater plants now accounts for about 15% (about 90 million m<sup>3</sup>/day) and has been targeted to provide 30% of the total water supply in Singapore by 2010.

Japan introduced Special Purpose Tax to preserve the eco-system, Forest Conservation Tax, increasing block charges and differential charges by water pipe size, preparation of "Guidelines for Waterworks (JWWA Q100)" and among several others a series of institutional reforms.

In the practical approaches for the application of the new development concept in the region, the Australian experience on the integration of the concept of Water Sensitive Urban Design (WSUD) in to socioeconomic development was found to be more relevant and could be useful to set as an example for other countries as well. The significance of the project was deployed as it integrates the modern guidelines with education of institutions, policy makers, professionals and politicians to understand the new paradigm of water management.

With the application of smart science Australia has developed sensors and smart-metering technologies that can be applied to change consumers' behaviors on how to use water. This technological advancement will enable consumers to opt for rational choices about what type of water they want to use in their houses and gardens.

One of the examples of successful urban river restoration project in Korea was the Taehwa river development which is restored from without any life in early 2000s to natural habitats of animals

and birds in recent time with improved river self purification system, river contamination control tool, natural environment improvements initiatives etc.

The award winning south East Queensland Healthy waterways is an outstanding example of catchment management and waterway health of the South East Queensland. The strategy enforced over 500 committed actions to maintain and improve the health of the water ways of the designated area with the specific focus on reducing urban and non urban diffuse source pollution, protection and conservation of the high ecological value waterways, improving management via better modeling and evaluation.

Eco-friendly approaches to enhancing dam construction and management in Korea with innovative solutions on how to use water more efficiently through state-of-art technologies and consideration of socio-economic elements. The reuse of treated sewerage water tanks to cutting-edge sewerage treatment technologies is another noble innovation As a non-physical infrastructure activity the government established several institutions, including the preparation of “Guidelines for Environmentally Friendly Dam Construction” in 2003 and the ‘Environmentally Sound and Sustainable Development Guidelines for Dam Construction’, in 2006.

#### ***5.4.2 Initiatives on eco-efficient water infrastructure development:***

The concept of reuse of water is very much relevant in present context where the part of world is facing its scarcity. The framework of integrated water management gives unique opportunities to implement planned water reuse as a sustainable practice. Reusing the urban wastewater will help ion improvement of river quality and provides a reliable water resource to the farmers. Waste water reuse is appearing as alternative water resource which can be safely used for irrigation and use of fertilizer also reduced by half. As the evidence yield of rice through wastewater irrigation increased by 20% as compared with the conventional irrigation water. There are no significant side effects due to nutrient rich irrigation water.

An example from the eco-efficient projects under the Korea Rural Community shows dedication towards eco-efficient development. Some other examples include, ground water well in Kenya, pivot irrigation in Sahara, Guinness World Records 2008 acknowledged, the Libya Great Man - made river as the world's largest irrigation project.

So the eco-efficiency is a development concept which promotes efforts of countries to enhance both economic and environmental efficiency at the same time.

There is need of adaptive management framework, which can accommodate the on going knowledge acquisition, integrated approach, continuous improvement in policy and critical role of monitoring.

#### ***5.5 WECS's Leadership role***

After the disintegration of Ministry of Water Resources into two ministries: Ministry of Energy and Ministry of Irrigation, the requirement of a Centralized Water Resources Planning Institute has been more critical. Drinking water Supply is under Ministry of Physical Planning and Public Works, and Department of Water Induced Disaster is under the ministry of Irrigation whereas the disaster cell of the government is under the Ministry of Home Affairs. This way the planning and implementation agencies on water sector are quite spread. This situation clearly calls for an integrated "Central Water Resources Planning Unit" which could centrally plan, coordinate and shape policies in association with other agencies in the water sector: *approach in line with the Integrated National Development Philosophy.*

WECS was established with the objectives to formulate and assist in developing policies and strategies in the water resources and energy sector and to provide suggestions, recommendations and guidance in the development of irrigation, hydropower, and drinking water projects. WECS is also mandated to formulate and develop policies and plans related to industrial use of water, flood management, in-land navigation, fisheries and other sectors related with water resources, along with the protection of the environment relating to the above sectors. WECS is further mandated to provide assistance to the concerned ministries in formulating policies and objectives to be included in the perspective/periodic plan relating to the water resources and energy sector.

Formally WECS, as a secretariat of the Water and Energy Commission (WEC), provides input and co-ordinates its activities with other existing policy level institutions such as the National Development Council (NDC), National Planning Commission (NPC), National Water Resources Development Council (NWRDC), and the Environmental Protection Council (NPC).

Even having all these strong and very important national policy formulation and development mandates, WECS is sketched to be a very low profile government agency. The general conviction is: professionals who are considered to be unwanted at other places are transferred to this institution. WECS is legally a separate organization but in practice it functions as a subsidiary office of the Ministry of Energy.

For the holistic planning and development in water resources in Nepal and specifically for eco-efficient water Infrastructure development, WECS is to be made practically strong, powerful and should be given a *de facto* leading role in planning, guiding, training, and policy formulation in water resources and energy sector. To meet this end, *capacity building of WECS* is essential, and in the field of water and energy, WECS needs to be *legally assigned the role of an apex body in formulating strategies, policies, planning and an advisory body in assisting the relevant ministries on all water and energy concerns.*

Apart of the above, WECS at the same time needs to be strengthened to provide the *leadership services and leadership role*. It has to demonstrate its capability in providing quick, efficient and elegant services to the concerned ministries, departments, and all relevant institutions/agencies.

## **6. Stakeholders' Workshop**

### ***6.1 Stakeholders' Consultation Workshop:***

On June 17, 2010 a Stakeholders' Consultation Workshop was organized at the WECS Hall in Kathmandu where representatives of the concerned ministries participated. They appreciated the initiation of eco-efficient water infrastructure concept and showed their interest in the application of this concept. In this context the participants recommended WECS to carry out investigation/studies to address the following issues:

- Investigate and suggest techniques to address the issue of deteriorating ground water recharge process in the Kathmandu valley. Carry out studies to control and manage haphazard groundwater pumping.
- Revise the National building code and carry out studies in making the rainwater harvesting cost-effective
- Research works are carried out by different institutes and without coordination; it has to be carried out by academic institutes.
- The traditional practice of flooded irrigation needs to be switched to appropriate eco- water efficient system.
- Developing a culture of holistic water management
- Improvement of regulatory framework

### ***6.2 National Stakeholders' Workshop:***

The National Stakeholder Workshop on Policy Concept on Eco-efficient Water Infrastructure in Nepal was organized by Water and Energy Commission Secretariat (WECS), Government of Nepal with support from UNESCAP, Thailand and KOICA, Korea held on 10 September 2010. which was attended by more than 40 participants from different organizations from government to International officials, INGO and NGO.

In the workshop the participant address the following issues:

- Urgent need of Integrated Water Resource Management policy to address 'Eco-efficient water infrastructure'.
- Optimum use of water resources and building infrastructure should be eco-efficient and green growth concept.
- Eco-efficient water infrastructure development for green growth.
- The challenges people facing on water resource in Asia Pacific region such as; inaccessibility to safe drinking water, scarcity of water, water hazards like; flooding due to urbanization, problem of too much water and too little water.
- The problem associated with too much water or too little water. So there is need of such infrastructure which can be economically feasible and environmentally sound. Infrastructure not only incorporates the physical infrastructures but also the policy, rules and regulations referred as the non physical infrastructure, should also be considered.
- Existing practices of eco-efficient water infrastructure in Nepal.
- The essential of green economy and green growth and the carbon trading, green technologies . Initiation of pilot projects and strategic policy to implement this concept and capacity building, way forward from the developed countries are of equal importance to implement

## 7. Programmes for Priority Activities

- Nepal has the traditional practice of storing monsoon water in big ponds, this culture is gradually diminished. This culture has to be reinstated with updated knowledge and technology and needs to be promoted extensively in all potential areas of Nepal.
- Kathmandu experiences great leakage problem in the drinking water supply sectors such as leakages from pipes due to poor maintenance, unethical leakages such as breaking the pipe for irrigation water, and meter vandalism. Others include poor or no conservation action of the drinking water sources, unscientific distribution system are some of the issues among others.
- The other priority programmes include mainstreaming eco-efficient water infrastructure in water sector, development of tools to screen water related projects through eco-efficient water infrastructure lens, and the issues as raised during the stakeholders' workshop on June 17, 2010.
- Capacity building programmes in the field of advocacy

- Advocacy programmes for policy makers

Eco efficient water infrastructure is a new concept and very few people know about it. Therefore several sensitization workshop/meeting/discussion/interaction programmes about Eco-efficient water- infrastructure need to be conducted so as to raise mass awareness about eco-efficiency. Special Guide Books are to be prepared especially to the policy-makers.

- Advocacy programmes for key line agencies

Similarly sensitization workshop /meeting/discussion/interaction programme about Eco-efficient water- infrastructure needs to be conducted to the key line agencies. Sharing knowledge base of good practice about Eco-efficient water- infrastructure is another activity. Providing short-term training and observational tour packages to the relevant persons will upgrade the quality of work and at the same time motivate the e persons concerned. Preparation and distribution of Guide- Books, examples of Good-practices, list of indicators to assess eco-efficient water infrastructure, reduction in the use of resources and others. More emphasis should be attributed to non-physical infrastructure rather than physical ones.

- Advocacy for implementing ongoing activities

Advocacy should focus on: Examination of the activity and integration of the activities with Integrated Water Resources Management ( IWRM) and eco-efficient water infrastructure concept. Conduct sensitization workshop/meeting/discussion programme about Eco-efficient water- infrastructure. Share knowledge base of good practice about Eco-efficient water- infrastructure. Preparation of Promotional education materials

➤ Development of strategic planning guidelines

Conduct a Stakeholder Consultation Workshop at the community, district, regional and national level and identify specific activities on eco water efficient infrastructures. In close coordination with the key line agencies identify challenges and opportunities and the gaps where IWRM and eco efficient water infrastructure concept could be incorporated and the space of cooperation. Strategic guidelines should encompass: a) Development of easy participatory mechanism for active participation and ownership. b) Sustainable and eco efficient water infrastructure and management of water resources sector. Provide planning guide lines and action plans on how to incorporate the eco efficiency dimensions.

➤ Sharing of information and technology

Information sharing is one of the key elements in water sector. Although sharing information/data is a difficult subject but without sharing information and technology, the water sector can neither develop nor flourish. The sharing should be among all the stakeholders from national to community level.

➤ Pilot projects in cooperation with government

Strong public-private partnership is to be build. Pilot projects are to be carried out in cooperation with the government and NGO/INGO/community level organizations.

➤ Investment in research

Research is another key element which has to be given priority. Investments must be made on research and development and HRD.

## **8. Recommendations and Conclusion**

The 3 year National Development Plan of Nepal (2011 – 2013) is being shaped now by the National Planning Commission of Nepal. All the water related agencies need to take this opportunity immediately to include eco-efficient water infrastructure projects in this national development plan. The assessment of eco-efficient water infrastructure is closely related to policy-making and implementation processes at the national level and hence awareness and sensitization activities are to be initiated with high priority so as to transform policy focus from physical infrastructure to non-physical infrastructure.

In spite of such variety of issues related to promotion of eco-efficient water infrastructure, it is vital to stress that such activities should be based on an active participation of diverse stakeholders in society.

Pilot research projects to be prompted to determine, eco efficient schemes that can be applied to water infrastructure development in Nepal. For example: transport system (using rivers for

navigation); buildings (enforcement of rain-water harvesting laws); irrigation (use of water-efficient system); agriculture (use of water efficient cropping pattern); hydro power projects (multi-purpose projects); roads and highways (alignment, design, bridges); water induced disasters and others.

Levee, as a conventional method of flood defense may also need further studies, if it could be replaced by other multipurpose schemes such as: 1) flood storage reservoir; 2) diversion to adjacent watersheds; 3) underground reservoir; 4) advanced flood warning and preparedness system.

Nepal has to address a list of challenges such as the growing population growth (5,638,749 in 1991, after 50 years in 1961 it was 9,412,996 and estimated population of 28,809,526 in 2008), providing reliable drinking water supply to the mass, providing and improvement of sanitation services, fulfill the growing energy demand, provide reliable irrigation system to address the crop-water requirements and a long list of issues.

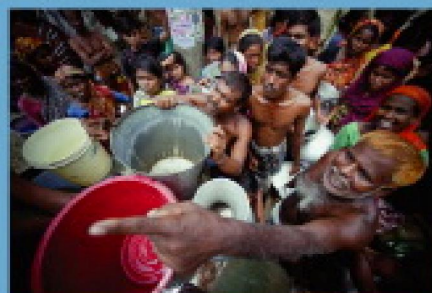
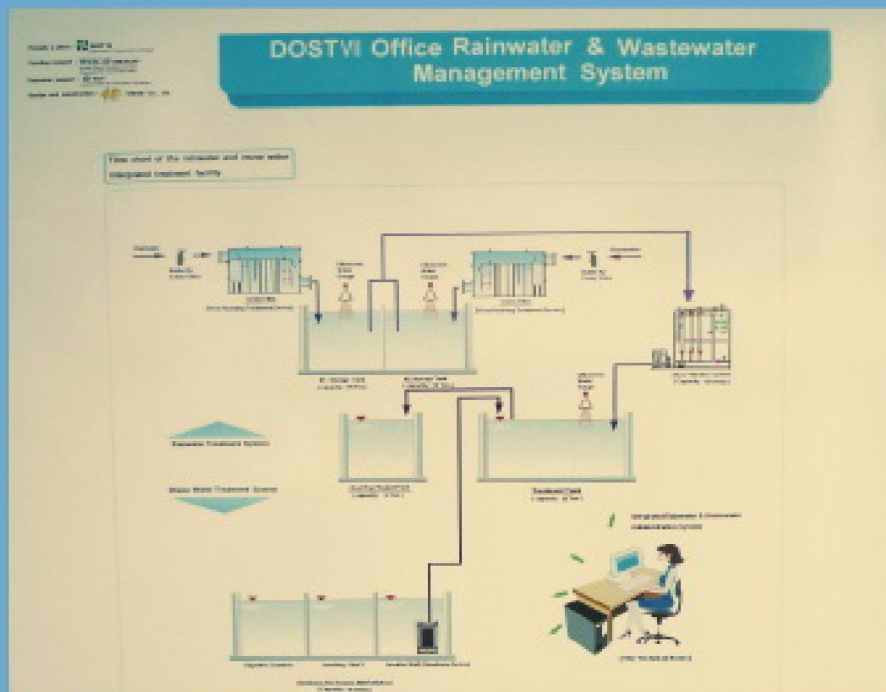
Development of the vast hydropower potential is crucial to underpin Nepal's overall economic development, poverty alleviation, addressing the development agenda and sustainable development. Depending upon the situation Nepal has to embark on the construction of mega hydro projects. If the multi-functions of the mega hydropower project contribute to enhancement of living standards and socio-economic well-being, contribute to water induced disasters, play important role in irrigation, recreation, navigation, ground water recharge, fisheries development and others, it is worth to frame a policy contemplating a sustainable and eco efficient approach to the design, construction, operation and maintenance of these large projects. Large dams have faced serious resistance from environmentalists and other activists but considering the climate change scenario, accelerated snow and glacier melt, increasing number of intense precipitation days resulting in high magnitude floods, erosion, landslides, low groundwater recharge, and other various issues.

The policy framework for Eco-efficiency Development should have a National Water Vision: "Present and future generation 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". The policy should also address the following points:

1. Develop Policy-paper based on the policy concept
2. Develop education-materials on eco-efficient water infrastructure in Nepali language and disseminate widely
3. Executing mass public awareness program on this subject
4. Conduct Regional Workshop outside Kathmandu
5. Conduct workshop to wake up the policy makers, decision makers and local people on "Green Growth" Concept.
6. Development of effective linkage between good watershed management practices and existing water supply utilities as means to improve eco efficiency;
7. Establishment of stable and strong institutional frameworks for the development and management of water resources;
8. Development of strategy for integrated planning;

9. Development of mechanism to get reliable and comprehensive data and information as support tools for decision making;
10. Development of effective linkage between good watershed /water infrastructure management practices and existing disaster management;
11. Integration of eco efficiency approach into existing legal mechanism.

The starting point to the eco efficient water infrastructure is: 1) Strengthening legal / institutional frameworks; 2) Sustainable water resource management; 3) Strengthening capacity development of water agencies; 4) Strengthening the integration of water agencies; 5) Provision of sustainable water infrastructures.



## Discussion Paper



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